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January 1955

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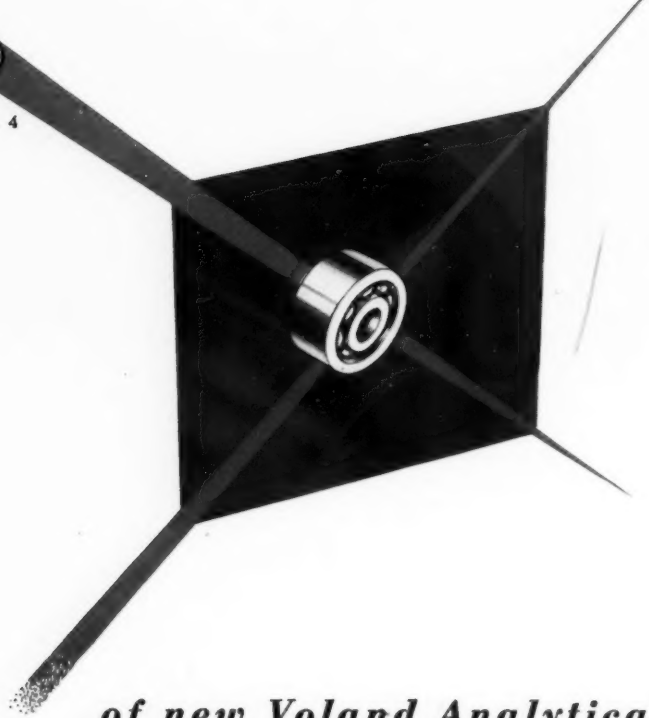

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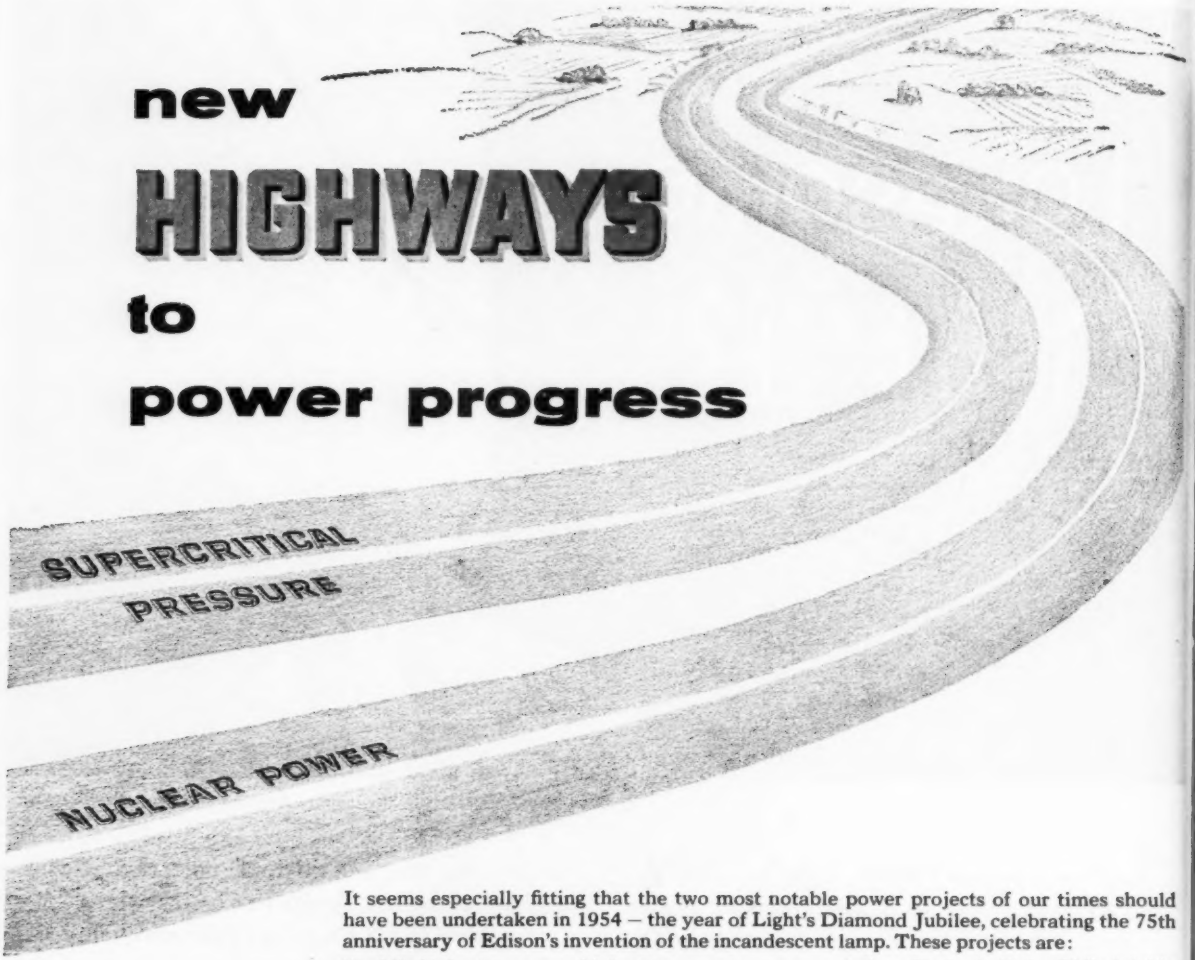

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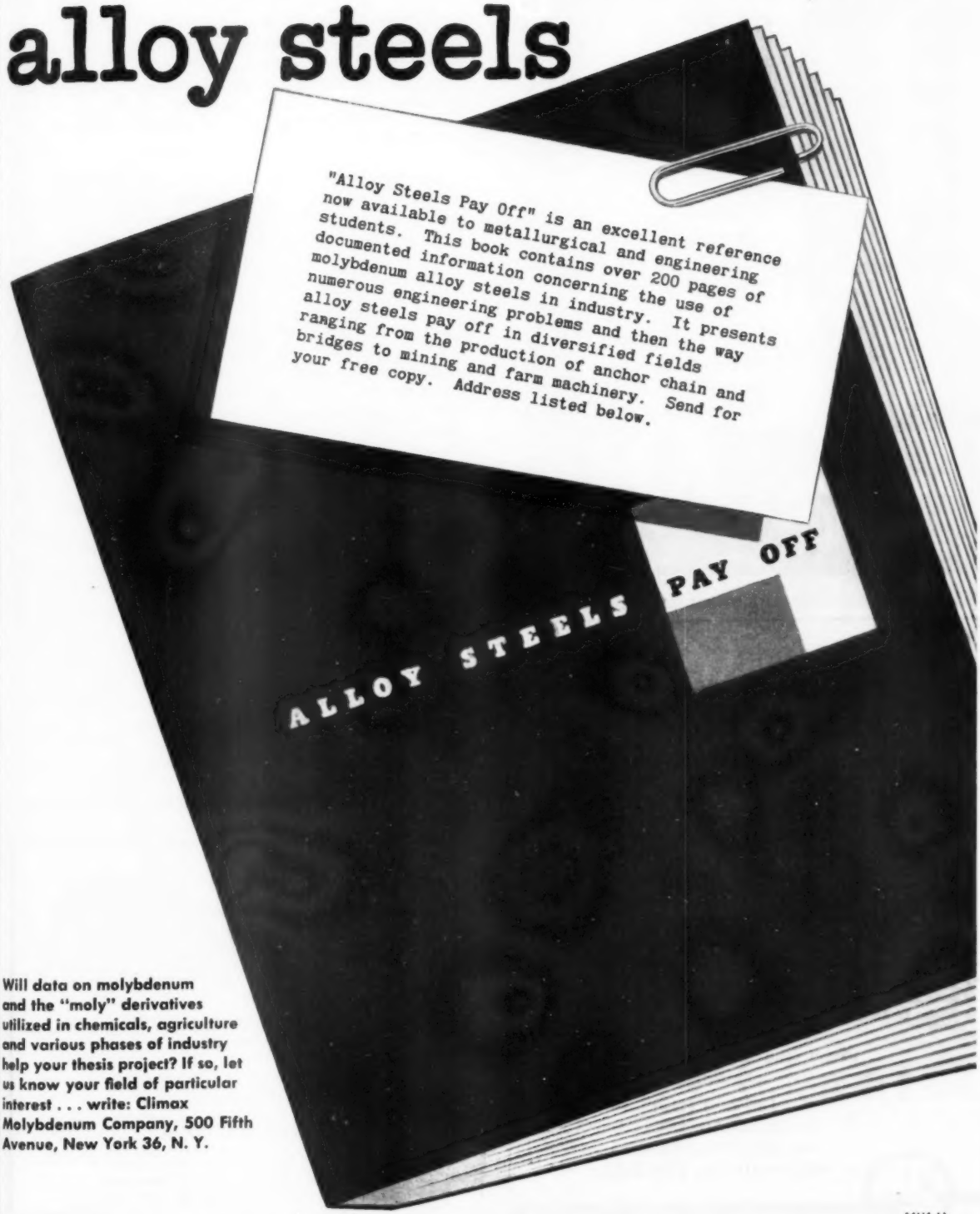
THE TABULAR VIEW

Maps, Interestingly Treated. — Man has wandered over the face of the earth long before he was able to record his activities. So long as his rovings were limited to the narrow confines of a day's walk or two, man learned to recognize his home territory through daily familiarity. But as man traveled farther afield, he needed charts to record his progress and mark the way for those to follow. The earliest known maps were crude drawings, without direction, scale or co-ordinate systems as we know them. As early as the beginning of the Christian Era, however, these features were incorporated in the maps of Ptolemy whose work represents the peak of ancient cartography. Map making fell into decline with the passage of the early Greek and Roman Empires and made its next important step with the invention of the printing press, introduction of the compass for nautical use, and the inauguration of the era of exploration. Today, maps of reasonable precision are available for the asking at gasoline service stations. The fascinating story of maps is told (page 133) by COLONEL JOHN G. LADD, who is a native of Missouri and a graduate of George Washington University with a degree in civil engineering. Before being called to active duty in 1941, he served 18 years with the United States Coast and Geodetic Survey in the fields of charting and mapping. After serving in England as Intelligence Engineer with the II Corps, he was assigned to Headquarters, 5th Army, serving as Engineer Intelligence Officer in Algiers, Morocco, and Italy. In 1946, on returning to the United States, he became Chief of the Engineer Intelligence Division of the Office of the Chief of Engineers. From 1949 to 1953 he was commanding officer of the Army Map Service. He was awarded the Legion of Merit for outstanding service in North Africa and Italy in planning mapping policies and directing the production of maps and survey data required for beach landing and invasion operations.

Minor Industrial Transformation. — A new era of technology was ushered in when the world's first atomic reactor was put into operation at Stagg Field at the University of Chicago during World War II. Since that time, much thought and effort has been expended on means for producing atomic energy for industrial purposes, and already the United States and England have made fissionable material available in support of President Eisenhower's "atoms for peace" plan. Desirable as may be such an objective, nevertheless, it raises questions as to how the new source of energy will affect existing industries. ROBERT E. WILSON, '16, answers the question (page 139) for the petroleum industry in his article "The Probable Impact of Atomic Energy on the Petroleum Industry" which was delivered as an address before the Atomic Energy Conference of the National Industrial Conference Board in New York on October 14, 1954. As chairman of the board of the Standard Oil Company (Indiana), Dr. Wilson's thoughts on this topic have special significance. Dr. Wilson received the Ph.B. degree from the College of Wooster in 1914, and the S.B. degree in chemical engineering from M.I.T. in 1916. He also holds more than half a dozen honorary doctorates. Except for service in the Chemical Warfare Service during World War I, Dr. Wilson was on the Institute's staff from 1916 to 1922. Since 1922, when he joined Standard Oil (Indiana), his responsibilities have become progressively great. He was assistant director of research, 1922–1928; assistant to the vice-president in charge of manufacturing,

(*Concluded on page 126*)

60 case histories of alloy steels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THE TABULAR VIEW

(*Concluded from page 124*)

1929–1930; director and vice-president in charge of research and development, 1931–1934; chairman of the board and chief executive officer since 1945. He was vice-chairman of Pan American Petroleum and Transport Company, 1935–1937 and president of that firm from 1937–1944. Dr. Wilson is a life member of the M.I.T. Corporation.

Maturity In Training. — A major function of any institution of higher education is – or should be – to develop maturity of thought and judgment in its students. One highly effective program is in operation at the present time at the Institute and is discussed in a two-part article by DR. DANA L. FARNSWORTH, who, as Medical Director, established the present program. The first part of Dr. Farnsworth's article (page 143) discusses those factors which facilitate the development of maturity; the second part, which will appear in the February, 1955, Review, will deal with the M.I.T. program. Dr. Farnsworth is a native of Troy, W. Va. He was graduated with the degree of bachelor of arts from West Virginia University in 1927 and continued his work to win the degree of bachelor of science in 1931. From 1927 to 1929 he taught chemistry and physics in the high school of Barrackville, W. Va., and then entered the Harvard Medical School, from which he was graduated in 1933. Dr. Farnsworth served his internship at the Massachusetts General Hospital from 1933 to 1935, when he became assistant resident in the sanatorium division of the Boston City Hospital in Mattapan. He holds the diploma of the American Board of Psychiatry and Neurology. From 1935 to 1945 Dr. Farnsworth was assistant director of health at Williams College and was granted a leave of absence to enter the medical corps of the Navy, in which he served as a commander on active duty from 1941 to October, 1945. During this period he was on the neuropsychiatric staff of several naval hospitals. He was medical director at M.I.T. from 1946 to 1954, and acting dean of students, 1950 to 1951. Technology's loss was Harvard's gain last summer, when Dr. Farnsworth became Henry K. Oliver Professor of Hygiene and Director of the University Health Services.

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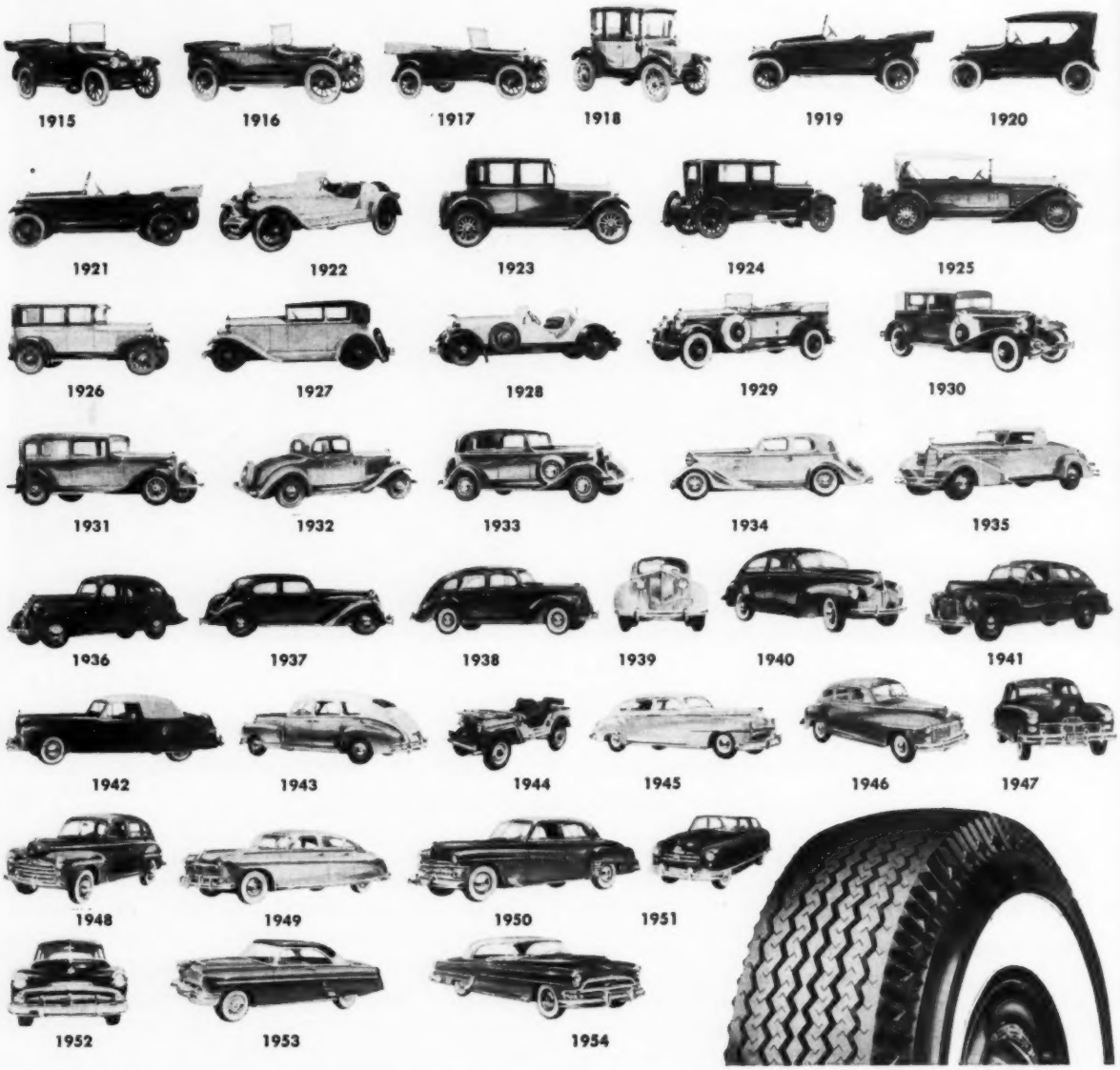

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Raymond E. Hanson

Mount Adams — in New Hampshire's White Mountains

THE
TECHNOLOGY
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The Trend of Affairs

Immortality in a Test Tube

In due course living things stop growing, then show signs of aging, ultimately die; all living things, that is, except parts of animals or plants maintained in tissue cultures. The animal connective tissue cells called fibroblasts, for example, kept in tissue culture so that they are well provided with food, and waste products removed, continue to grow vigorously for indefinite periods of time. Thus although the life span of domestic chickens is but a few years, chick fibroblasts placed in tissue culture decades ago are still growing as lustily as ever; and barring some technical accident to the cultures apparently will continue to enjoy perennial youth forever. Tissue culture is indeed immortality in a test tube.

Pioneer work done by Alexis Carrel, around 1910, is the basis of modern tissue culture. The techniques used are essentially simple, but require fastidious care and great skill. Successful tissue culturists are artists as well as scientists; they need to possess some indefinable attribute analogous to the green thumb of the successful gardener.

Basically, tissue culture involves placing a bit of tissue, freshly cut from a living animal, in a clot of coagulated blood plasma within a glass container. All materials and implements must be sterile and all manipulations carried out aseptically, because if bacteria enter the cultures they quickly destroy the tissues. Tissue cultures are incubated at body temperature. They are supplied with food in a nutrient fluid, and are washed periodically to remove waste products. The culture containers may be held stationary, or may be slowly rotated by machinery to effect circulation of the nutrient fluid.

A recently developed variation stems from the observation that cells in culture will adhere to a smooth impervious surface, such as glass, and grow along this surface in a thin sheet. To provide a large surface area, crumpled cellophane or a mass of tiny glass helices may be placed within the culture container. This procedure makes unnecessary the use of a plasma clot to support the tissue. It also enables production of cultured cells in vastly greater quantities than heretofore possible.

Tissues grown in culture often lose their characteristic form and arrangement, but usually retain their biochemical characteristics. For example, liver cells in culture cease to look like normal liver cells under the microscope; but continue, like normal liver cells, to accumulate glycogen. Work is now being done on the growing of whole animal organs as intact structures. A number of organs taken from embryos, and a few from adult animals, have so far been grown in tissue culture as organized entities.

Animal tissues were the first to be cultured. But today plant tissue culture is in the forefront, mainly because of the inherent hardiness of plants, which makes their maintenance in culture relatively easy. Thus a variety of plant tissues thrive in culture when provided with nutrients consisting of a few chemicals of known identity. Human or animal tissues, contrariwise, usually grow only when provided with embryo juice, a complex mixture whose chemical constitution is not fully known. So long as this unknown factor is involved in animal tissue culture, a strong element of obscurity remains.

Complete plant organs, such as roots, may be maintained in culture. Plant embryos, dissected out of seeds, thrive in tissue culture and mature into adult plants. Even entire plants – for example duckweed, the tiny green plant often seen covering the surface of stagnant fresh water ponds – thrive in tissue culture.

Tissue culture has been called the most powerful instrument for research in cellular physiology. Its particular value is the opportunity it affords to study

living cells away from the complex and confusing environment created by other tissues, of different types, within the intact animal or plant. It is even possible to take motion pictures of changes within cells as they grow in tissue culture.

A number of human, animal, and plant tumors thrive in tissue culture. Hence this procedure is fruitfully used today in cancer research, and also in studies of plant tumors. Some tumors can be maintained for a while in culture, then transplanted back to animals or plants.

Aside from its unparalleled research value, tissue culture has become a tool of considerable practical utility. Modern orchid growers use tissue culture techniques routinely. Horticulturists have begun to use embryo culture to develop new varieties of garden flowers and trees. The seeds of such higher plants often take years to germinate; and then the plants may have to grow for additional years before it can be seen whether they possess the characteristics sought. By dissecting embryos out of seeds and growing them in tissue culture, the entire sprouting and maturing cycle is greatly accelerated, and may be accomplished within a span of weeks instead of years.

Binding of Small Anions

RECENT studies of the physical chemistry of protein solutions, conducted by Professor George Scatchard and his co-workers in the Department of Chemistry, are aimed at determining the means by which small negatively charged ions are bound to proteins. As in all scientific research, the studies are aimed at contributing to man's knowledge, and the primary usefulness of current studies on relatively simple reactions is the light they may be expected to throw on more complex ones, such, for example, as those involving enzymes.

Nevertheless, this knowledge is not without potential utility. Indeed pharmacologists are already making applications which depend only upon the knowledge of general principles and of the fact that some molecules are bound more tightly than others. If they want a drug to act very quickly and to stop soon, they choose one that is not bound much to albumin or other plasma protein. If they desire a drug which will act slowly over a long period of time, they look for one that is bound tightly to some sites that are present in relatively large concentrations.

The study thus far has been concentrated upon the plasma proteins, particularly upon albumin, the most abundant, and in many ways the most active. Serum albumin has a molecular weight of 69,000 and contains 10,000 atoms, about half of which are hydrogen. Its molecule is probably shaped like a long egg or a fat cigar. The neutral molecule contains about 100 positive charges, mostly on substituted ammonium groups, and 100 negative charges, mostly on carboxyl groups. In the plasma, 20 of the ammonium groups have each lost a proton, so each molecule has a net negative charge of 20.

Much of the reactivity of — and therefore the interest in — albumin depends upon these 200 charged groups, since each tends to provide a site at which ions of the opposite charge may be bound to the molecule. Investigations under way aim to determine how many of each type of ion may be bound, and what practical use can be made of this knowledge. The tightness by which an ion or small molecule is bound to a protein at a particular site is measured by the pK. This pK is the negative logarithm of the concentration of the small molecule, measured under somewhat idealized conditions, when the chance of a small molecule being bound at a site is equal to the chance that nothing is bound there.

Protons and small positively charged ions behave, with respect to the groups bearing charges in proteins, much as they behave with respect to the same groups in smaller molecules. Hence studies on small molecules hint at results we should expect to obtain with large molecules.

The small anions behave very differently. Each of the amino groups in proteins appears capable of binding an anion if the concentration is sufficient, although the same groups in small molecules are not able to do so. Moreover, there are several sites in serum albumin with much larger values of pK than in any other molecule which contains the same amino acids.

The studies of the binding of small anions have recently benefited from anion exchangers in two ways. They enable more complete elimination of small ions and better purification, and, in the form of membranes, ion exchangers can also be used as electrodes.

When an electrical potential is applied across a membrane of a strong base anion exchanger, the positively charged ions are fixed, and any current that flows is carried by small anions. The membrane process involves the transfer from the aqueous solution on one side to that on the other of one equivalent of a small anion for each equivalent of electricity, and the membrane is an anion electrode in the same sense that a glass electrode is a hydrogen electrode. A strong acid cation exchanger differs in that the fixed ions are negatively charged, and any current that flows is carried by small cations. A pair of anion and cation exchanger membranes may be used to measure the chemical potential of a salt in a protein solution.

Using these membranes, James S. Coleman, '54, in his doctoral thesis with Professor Scatchard, has found that chloride ion is bound to one site on each neutral human serum mercaptalbumin with a pK of 3.4, to eight other sites with a pK of 2.0 and to 18 others with a pK of 0.5. They also found that the iodide ion is bound to the same number of sites, but the value of each pK is 0.6 greater in this case than with chloride ions. With Mrs. Amy L. Shen, '53, research assistant, they found that thiocyanate and trichloroacetate ions are probably bound at the same sites with values of pK 1.3 greater than those found for the chloride ion.

The greatest usefulness of these results will probably be that the better understanding of these relatively simple interactions will help in understanding more complex ones. The next step in understanding is to learn the nature of the sites at which ions are bound. This will require studies with other anions, with other proteins, and with proteins modified in some known way.

Maps, Old and New

Man's Knowledge of the Surface of the Earth Has Been Greatly Facilitated through Major Contributions from Astronomy, Mathematics, Surveying, and the Graphic Arts

By JOHN G. LADD

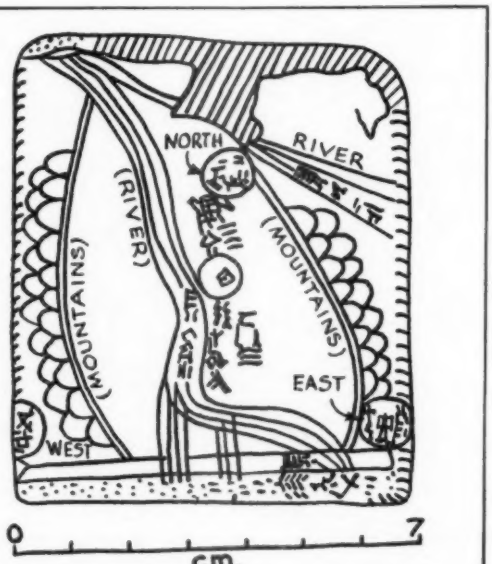
MEN have been making maps for thousands of years. They have expanded and improved types and mapping techniques, but basically the purpose of a map today remains what it was in the beginning – to show men how to get from one place to another. As man broadened his horizons, both geographically and scientifically, so his need for more and better maps increased in like ratio. Whereas the Phoenician sailor required knowledge of only a few hundred miles of Mediterranean coast line in his travels, today's pilot of a commercial jet air liner, flying a scheduled trip from London to Cape Town in less than 20 hours, must know his position over thousands of miles of land and water.

Going back thousands of years we find that one of the earliest known maps is a clay tablet some 4,500 years old, discovered by archaeologists near Babylon. On this tablet, the unknown cartographer drew a range of mountains near a river (probably the Euphrates). In portraying what was perhaps his entire known world, this draftsman symbolized his mountains with a "fish-scale" pattern.

The Chinese were also mapping their own country before the Christian Era, with the earliest reference to one of their maps dating back to 227 B.C. In fact, much of China had been "mapped" after a fashion, before the first visit by Western man. One Chinese map of the empire was made of wood blocks that could be taken apart like a jigsaw puzzle, province by province. After the invention of paper (100 A.D.) the Chinese made maps, probably for administrative purposes, covering all parts of their country. In their mapping, the Chinese depicted the earth as a flat surface with China in the center.

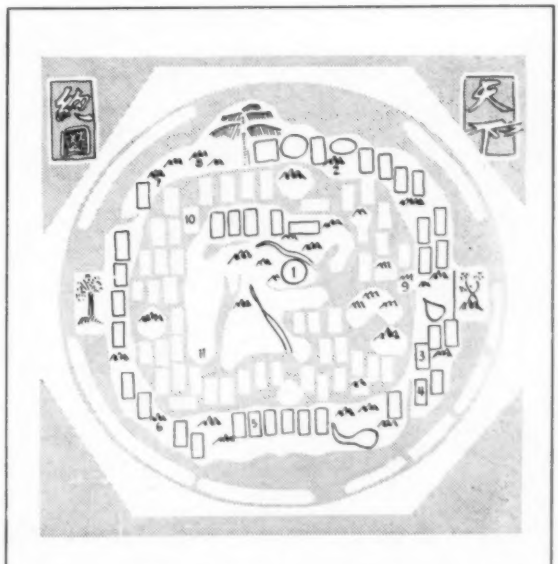
In the ancient Greek civilization, cartography was developed to a point not equaled again until the Sixteenth Century. The Greeks suggested theories of the earth's spherical shape, and its poles, equator, and zones; they developed concepts of latitude and longitude, devised the first projections, and calculated the size of the earth.

Outstanding among Greek cartographers were Eratosthenes, Poseidonius and Ptolemy. Eratosthenes (c. 276–194 B.C.) measured the circumference of the



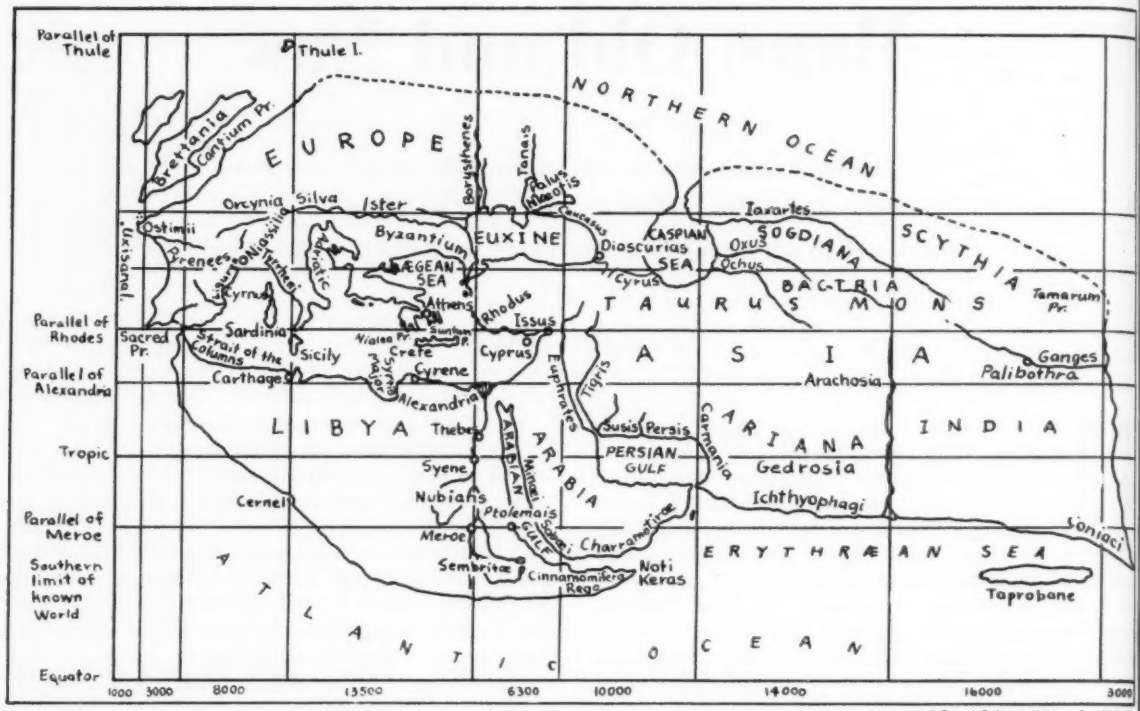
Adapted from General Cartography *by Raisz*

Fig. 1. Clay tablet in the Semitic Museum of Harvard University is believed to be 4,500 years old, and to be the world's oldest map.



Adapted from General Cartography *by Raisz*

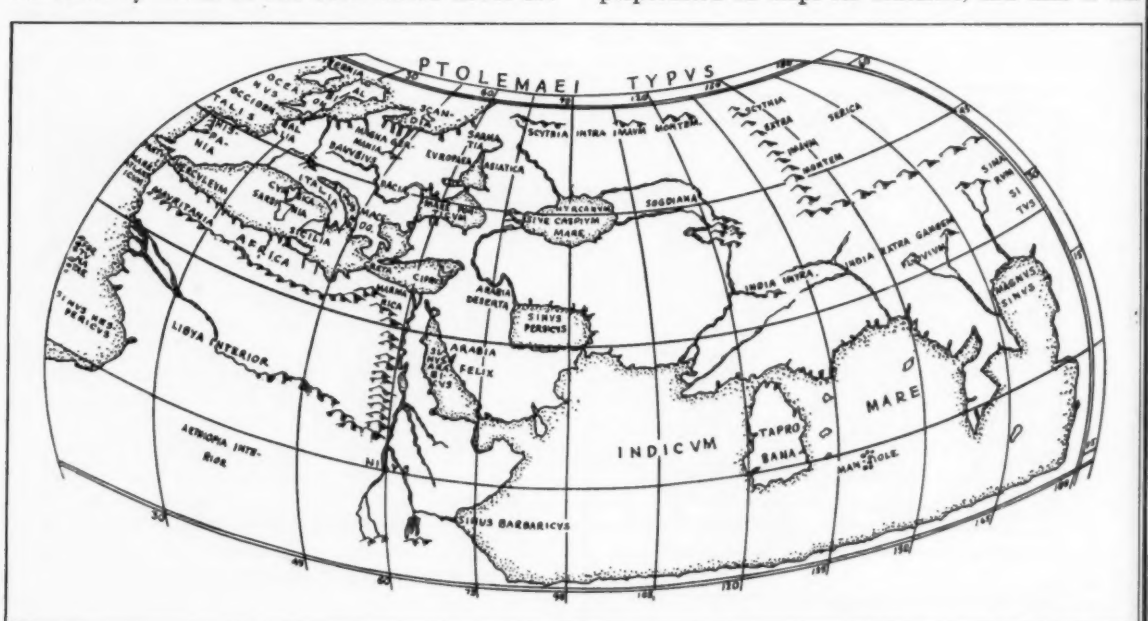
Fig. 2. Old Chinese map, showing China (circle with 1 in center), India (11), and land of white people (10), places North at top.



Adapted from Maps by Birch

Fig. 3. Eratosthenes of Alexandria pictured the world of about 200 B.C. as shown above, with arbitrarily selected network of meridians and parallels.

earth, using Egyptian land surveys and the angle of the noonday sun at two points, Alexandria and Syenê. Considering scientific knowledge and equipment in his day, the accuracy of his measurements was remarkable. Poseidonius (c. 130–50 B.C.) measured the earth by means of star observations about 100 years after Eratosthenes. His measurements, based upon the accepted, though incorrect, distance between Alexandria and Rhodes, unfortunately resulted in a figure one-quarter too small for the circumference of the earth. This geographical understatement was perpetuated on maps for centuries, and thus it was



Adapted from Story of Maps by Brown

Fig. 4. The world of Ptolemy indicates recognition of the spherical nature of the earth. Latitude is designated by the number of hours in the longest day of the year. Longitude is expressed in fractions of hours east of the mythical Fortunate Islands in the general vicinity of the Madeira or Canary Islands.

that Columbus, thinking that the Western Sea did not appear too wide or forbidding, attempted to reach the Indies by sailing westwards.

Perhaps the most influential figure in cartographic history was Ptolemy (c. 90–168 A.D.). His *Geographia* constituted the first general atlas of the world, containing, in addition to numerous maps, descriptions of two projections and a list of 8,000 places with their locations given by latitude and longitude. His use of lines of latitude and longitude was the chief revolutionary feature found on his maps. Ptolemy also oriented his maps to the north and insisted on the sphericity of the earth in his writings. During Ptolemy's lifetime, cartography reached its highest point of development; soon after, it went into a decline and only emerged again toward the end of the Middle Ages, with the voyages of the Genoese, Spanish, and Portuguese seamen and navigators. Ptolemy's great *Geographia* was lost for hundreds of years until it reappeared during the Fifteenth Century.

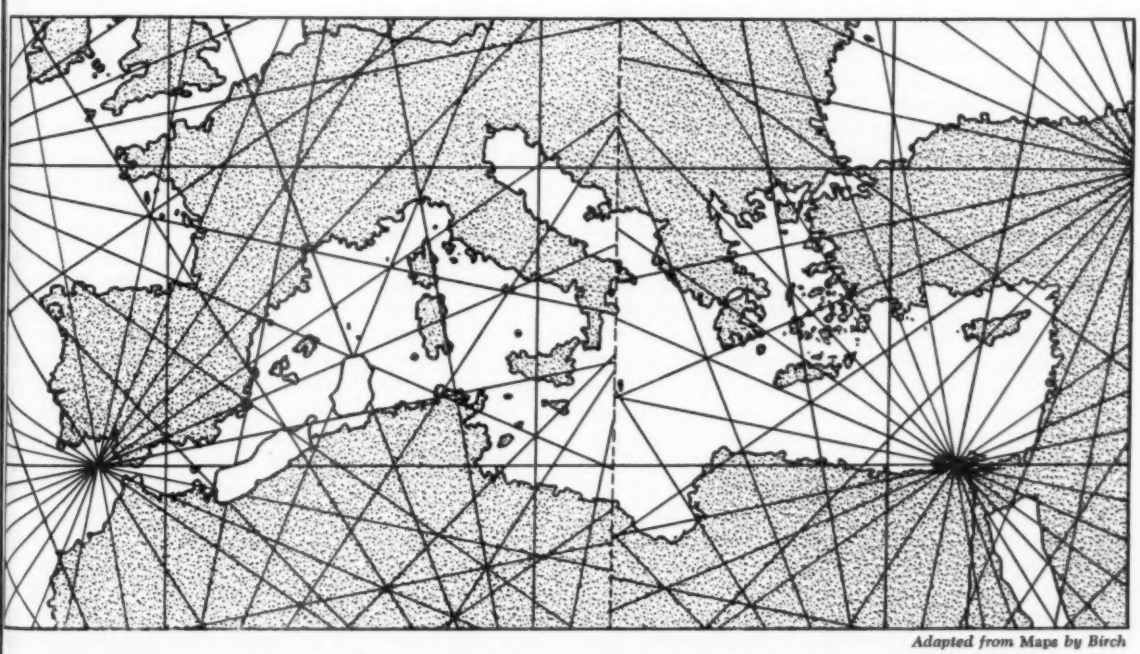
The Roman Empire at the height of its power had complete map coverage of its communications and all the lands in its empire. Many Roman maps were road maps, which gave mileages, military posts, and place names. The Peutinger Table, best known among them, showed the Empire's roads in the Third Century A.D. Also well known was the *Orbis Terrarum*, which portrayed the three great continents with Asia and the East at the top of the map; from this practice came the term "orientation." East remained at the top until the introduction (about 1302) of the compass.

During the Middle Ages with the disintegration of the Roman Empire the power of the church was rapidly ascending. This period showed little or no advances in any of the sciences, including cartography.

Adapted from Story of Maps by Brown

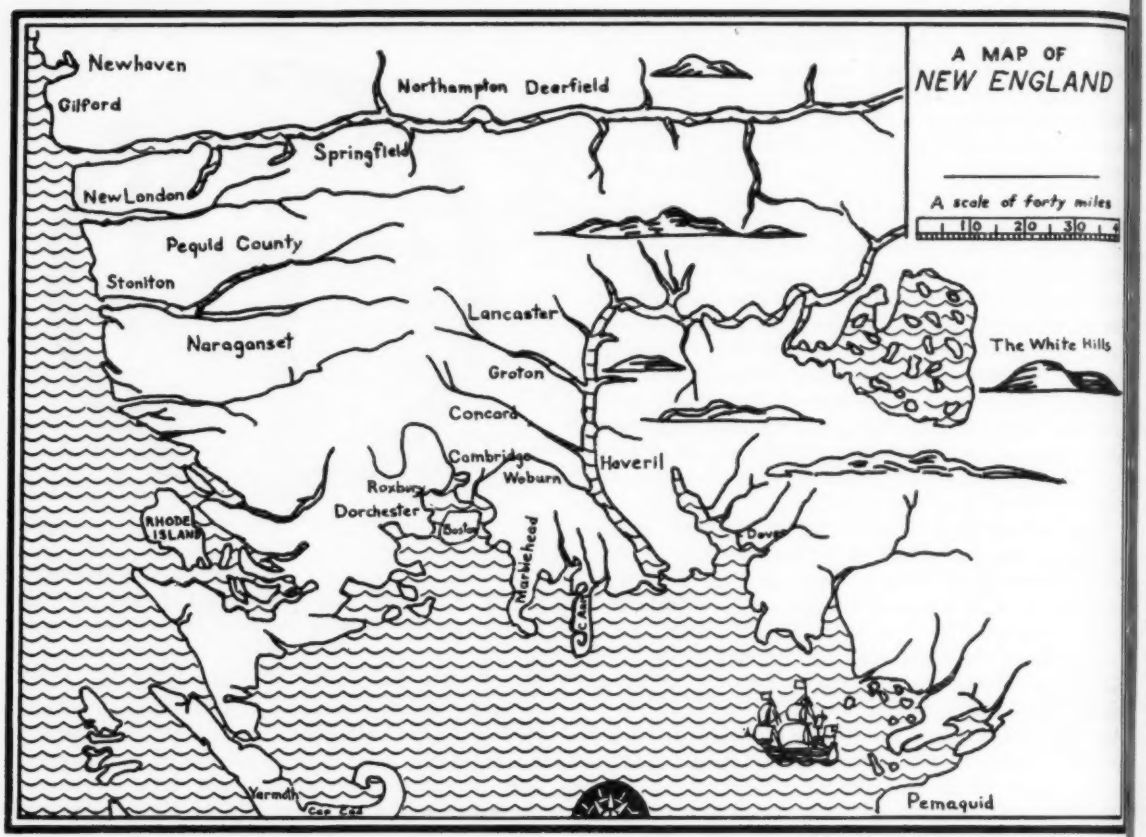
Fig. 5. A "T-in-O" map of the world of about 900 shows East to top, with Paradise and Eden part of Asia. Europe is at the lower left.

European maps of the early Middle Ages included two main types: decorative illustrations of theological texts and practical sailing charts. The first was usually made by men who, greatly influenced by the church and legendary literature, made little attempt to show the world as it actually is. These maps were not accurate; accuracy was not possible at that time nor even considered desirable. The map-maker of the Middle Ages also believed the world to be disk-shaped. He thought that Paradise and the Garden of



Adapted from Maps by Birch

Fig. 6. Portolan chart of 1500. Such maps were prepared especially for use by sailors, and accordingly, show coast lines (particularly of the Mediterranean Sea and adjacent areas) with greater accuracy than had previously been customary. Rhumb lines from selected points were inserted as aids to navigation.



Adapted from General Cartography *by Raiz*

Fig. 7. First map drawn, engraved, printed, and published in the American colonies was reproduced from a woodcut by John Foster, done in Boston in 1677. West is at the top.

Eden were situated in the East, which he, too, usually placed at the top of maps.

Cartographers call world maps of this period "T-in-O" maps. They show the world as a circle within which is a "T" dividing the world into three parts. Asia stood above the crossbar of the "T," and Europe and Africa beside the stem. These maps were highly decorated with many legendary symbols.

From the Thirteenth through the Sixteenth Century the Portolan Charts provided the world with the first really practical map. These sailing charts, probably made by Italian seamen, displayed an accuracy never before known. Most of them showed the Mediterranean, Black Sea, Atlantic Ocean to Ireland, and northern cost of Africa; and since they were sailing charts, the Portolani showed greater detail along the coasts than inland. These maps bore compass roses and rhumb lines crisscrossing their surface; these innovations were undoubtedly designed to help navigators fix their courses. Two other features made these charts unusual: the placing of North at the top of the map and a correction of earlier overestimations of the Mediterranean's length.

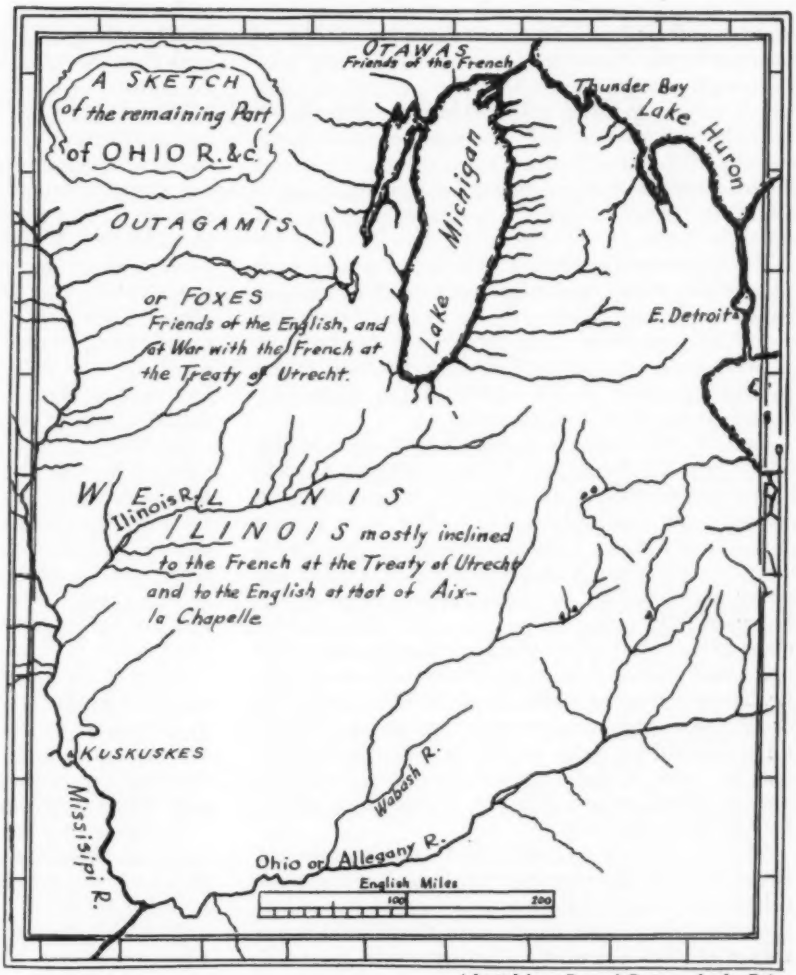
In the Fifteenth and Sixteenth Centuries several factors gave a notable stimulus to map making. They were the rediscovery of Ptolemy's *Geographia,* translated into Latin about 1405; the invention of printing and engraving; and travels, such as those of Columbus, Magellan, Drake, and Marco Polo. Explorations stimulated production of maps and the new maps, in turn, stimulated new explorations.

This era produced great cartographers. Among them, the Flemish Mercator (1512–1594) was perhaps the first modern map maker. He utilized in his maps the scientific theories of Ptolemy, the practical charts of his day, and his own travels. The Mercator projection first appeared in 1569 on his World Map, probably the most famous map in the history of cartography. His projection was not, however, generally used on navigation charts until the middle of the following century. Mercator also devised the secant conical projection, made globes, and eliminated from his maps some of the pictorial features formerly used.

Contemporary with Mercator was Ortelius of Antwerp. He issued, in 1570, the first modern atlas, *Theatrum Orbis Terrarum,* containing some 500 maps and views of cities. Ortelius showed North and South America distinguished as such for the first time.

The Sixteenth Century brought the *Atlas of England and Wales* (the first printed maps of English counties) by Saxton, pioneer of English cartography, and Norden's Estate Surveys. The latter's maps were the first to show a reference grid. Another notable English map was the chart of the world in 1599. Constructed on Mercator's projection, this map depicted Drake's voyages.

In the Seventeenth Century appeared the first map made in America, a crude woodcut by John Foster, pioneer Boston printer. (On it, West is shown at the top of the map.) During this century, the Dutch, Italians, British, and French produced numerous world maps as well as many maps of their own countries. The Eighteenth and the early Nineteenth Century constituted an age of almost constant warfare in Europe. The armies needed maps to move troops and to enable artillery fire to reach its objectives. This period saw the growth of military maps, especially topographic maps, as army commanders learned their value. France and England dominated the period and their military activities, especially Napoleon's campaigns, stimulated production of surveys and maps at a greatly accelerated pace. France made the first national survey based on triangulation and astronomic observations. Cassini, a scientific cartographer, provided the impetus for this survey, which led to the topographic map of France about 1750. Produced at the scale of 1:86,400, this map remained the standard French map for many years, being fully replaced in 1914. Although this map depicted relief by hachures, the age of contours (which indicate relief in measurable terms) was beginning. Contours had first been used in the early Eighteenth Century to portray a river bottom. Among the cartographers who appreciated contouring was Laplace who persuaded the French Government Surveys in 1816 to adopt the use of contours on their maps.



Adapted from General Cartography *by Raisz*

Fig. 8. The Lewis Evans map of the Middle British Colonies was produced in 1755, from copper plate cut by James Turner. The map was printed in Philadelphia, possibly on presses owned by Benjamin Franklin.

The late Eighteenth Century brought the triangulation of England by General William Roy and the connection of the London and Paris observatories by triangulation. The first map, one-inch-to-one-mile, resulting from the Roy survey, appeared in 1801. John Cary's map of England, Scotland, and Wales, using Greenwich as prime meridian, came in 1794. At first practically every country adopted its own prime meridian, usually the one through its capital. Greenwich is the prime meridian used on most maps today.

While the Europeans were busily engaged in producing fairly accurate maps of their own countries, the colonists in North America were beginning to take up mapping in a fairly extensive way. Perhaps the outstanding American map of the Eighteenth Century was Evans' map of "The Middle British Colonies, 1755." George Washington, both as a surveyor and later as a General during the Revolutionary War, was deeply interested in cartography. He realized from his experiences during the Revolution, how the lack of accurate maps hampered military operations.

The Nineteenth Century brought both expansion of territory and increased interest in maps in America. The first geologic map appeared in 1809, the first atlas in 1823. In the mid-Nineteenth Century, Matthew F. Maury, pioneer of scientific oceanography, produced his charts of ocean currents compiled from sailors' logbooks.

One of the major developments of the Nineteenth Century was the International Map of the World at the scale of 1:1,000,000. A young geographer, Albrecht Penck of Vienna, suggested this map at the Fifth International Geographical Congress at Berne in 1881, but no sheets appeared until 1909. This new mapping concept permitted compilation of a series of maps of international scope, uniform in scale, legend, and projection. More than 30 countries share in the project and although some 400 sheets have been pub-

lished, world coverage is still far from complete. Among the published maps, those of Hispanic America by the American Geographical Society provide continental coverage. Useful for internationalist and historian, the One Million Map is a remarkable example in international co-operation. The great amount of detail shown on maps of this scale and the extensive land area covered by each sheet, make this series ideally suited for military planning and strategic studies.

The Eighteenth and Nineteenth Centuries also gave cartography many new instruments and techniques for making maps. Among the instruments were the octant, chronometer, and theodolite. Methods of showing relief, such as hill shading, hachuring, and contouring added to the utility of the maps produced during these two centuries.

Probably the major technical development of this period was the invention of lithography in the late Eighteenth Century. Copies of early maps were hand drawn. Later (until about 1800), they were usually engraved on wood blocks, although copper plates came into some use in the Sixteenth Century. Lithography, employing flat-bed lithographic machines, was first used for printing of maps in 1846. This enabled maps to be produced in quantity, thus lowering their price, and making them available to the general public. Toward the end of the Nineteenth Century, zinc or aluminum plates began to replace stone as the medium for printing maps by lithography. These plates can be used in high-speed rotary offset printing presses. Most maps today are produced by photolithographic processes.

The most significant feature of modern cartography is emphasis on topographic maps which will provide a base for illustrating a variety of problems and information concerning human activities. The developments of the Twentieth Century have constantly created demands by both civilian and military users for more accurate, detailed information on maps. Accelerated urbanization and consequent development of industrial areas have made property more valuable. Therefore, records of buildings and ownership of land become increasingly important. Vastly increased mechanization of travel and transport has augmented the need for information concerning roads, railroads, and air routes. Communication facilities – telephone, telegraph, radio – require more and more information. Public utilities – gas, water, and electric power – call for accuracy of detail.

Even small-scale maps must be as accurate as possible. This need places stringent requirements on the cartographer. Not only has the need grown for more accurate detail, but instruments and techniques have become more numerous and complicated. The development of mapping equipment has kept pace with the requirements. The cartographer of today must be highly trained to comprehend the processes necessary for making a modern map.

A modern map includes more than proper locations of natural and man-made features. For example, today's cartographer lays great stress on correct spelling of names for countries, provinces, mountains, streams, cities. Much research goes into this problem before names appear on the finished map. Questions of boundaries, both international and internal, also require attention. Constant vigilance is exerted to assure that the information shown shall be the best available.

Portrayal of relief constitutes one of the most important features of a topographic map. Contours are the most accurate method of indicating relief. They are often, however, supplemented by hill shading, altitude tints, spot heights, form lines, and hachuring. In addition to these methods, military mappers have been working on relief, or three-dimensional, maps since World War II. Some of these are small-scale, showing a whole country or continent; some large-scale, giving a visual portrayal of a small area. Relief maps are unequaled for teaching users to interpret land forms. The U. S. Army Map Service has produced a number of plastic relief maps in recent years.

Modern map symbolization is based on a planned view of the earth's features from above, in contrast to that on early maps which showed many of them from eye-level and therefore in profile. However, today's map makers have returned to pictorial representations for conventional symbols in a few cases. For example, they frequently use individual tree symbols for forests or orchards and profile views for sand dunes.

Some of the numerous interrelated sciences which are contributing in the production of modern topographic maps are:

1. Geodesy, in dealing with the shape and dimensions of the earth, plays an increasingly important role in the preparation of accurate maps.

2. Electronics has made many contributions, ranging from computing machines such as UNIVAC (for making geodetic calculations) to locating devices such as SHORAN.

3. Aerial photography and its corollary science, photogrammetry, have revolutionized the speed and accuracy of map making.

4. The use of helicopters which supplement or often replace fixed-wing airplanes in aerial surveying is helping to solve the problem of surveying in areas of rugged terrain.

5. Radio provides time signals for establishing longitudes in aerial surveying.

In spite of the many advances in cartography, less than 1 per cent of the land area of the earth is adequately mapped at large scale. In 1946 the Joint Mapping and Photographic Committee began standardization of topographic map symbols and specifications for use by U.S. Federal mapping agencies. Technical Manuals prepared under this program cover all phases of map preparation. They were used as a basis for agreements on standardization by the United States, Great Britain, and Canada and are also serving as the foundation for similar agreements by North Atlantic Treaty Organization countries.

The N.A.T.O. program illustrates the vast importance of maps in international relations. One of the first steps called for supplying N.A.T.O. countries with adequate maps. This effort involved printing some 90,000,000 maps – the largest single project in the history of military mapping. The maps for the N.A.T.O. aid international understanding by bilingual

(Concluded on page 166)

The Probable Impact of Atomic Energy ON THE PETROLEUM INDUSTRY

For the Next Quarter Century, Atomic Energy Is Viewed As an Aid to, Rather Than a Competitor of, the Oil Industry

By ROBERT E. WILSON

In the past half century of amazing development and change in this country, one of the most dramatic shifts has been in the sources that supply our expanding needs for energy. At the turn of the century the statistical information was none too accurate, but best estimates are that the burning of coal provided about 70 per cent of the energy supply of the nation. The burning of wood provided about 20 per cent. The remaining 10 per cent of the energy market was divided between oil, gas, and water power.

By the end of World War I, oil and gas had grown to about 15 per cent of the total. Today they supply close to 60 per cent of the country's energy. Coal has faded and wood has been almost eliminated. Although we have a larger population than in 1918 and use much more energy per capita, the country's coal tonnage has actually decreased.

Now we are entering what is widely heralded as the Atomic Age. The release of atomic energy is probably the outstanding scientific achievement of the century. People are naturally asking whether atomic energy will in the next few decades do to oil what oil and natural gas have done to coal and wood. What, if any, threat does the new challenger pose to the reigning champion.

In trying to appraise the probable impact on our industry, let us disregard the views of a few incurable optimists, who focused their attention only on the enormous power theoretically obtainable from a pound of uranium and were sure, way back in 1945, that atomic energy would soon be producing large quantities of power. Let us also disregard the views of the pessimists, who feel we may never solve the serious problems that still prevent the economical production of atomic power for commercial purposes. Fortunately, there is today a great body of fact and informed opinion which gives one a well-established base between these two extremes.

The author yields to no one in admiration for the research done in government, university, and industrial laboratories on the many problems involved in producing power from atomic fuels. However, it is fair to say that this research has uncovered almost as many new problems, unsuspected in the early days of rosy optimism, as it has fully solved of the problems then recognized. That is not surprising because the military aspects of atomic energy have necessarily had priority during the hectic years since World War II, and the research achievements in that area have been truly amazing. Power generation has been largely an incidental by-product of this great program. If anyone claims that the new Atomic Energy Act turns over to private industry a bonanza in the form of already solved technical and economic problems and an assured profit, either he does not know the facts or he is an arrant demagogue. Any private investment in commercial atomic power generation in the near future will have to be inspired more by public service motives than by any reasonable expectation of substantial profit.

Development of Commercial Use of Atomic Energy

In discussing the probable rate of development of the commercial use of atomic energy, commercial use, basically, is defined as production of power at costs, including depreciation, which are competitive with power from conventional fuels, and without direct or indirect subsidy from the government. This criterion is used because it is hard enough to appraise the complicated economic factors that will affect the outcome, without trying to take into account the unpredictable political and other factors that might lead to all sorts of open or concealed subsidies. Most of those, both in government and industry, who predict early commercial developments by private enterprise are assuming such subsidies. In some cases, especially in some of the underdeveloped, power-hungry countries of the world, subsidies may well be justified, but they nevertheless are subsidies.

Specifically, to qualify as unsubsidized, a commercial power development:

1. Should pay for its uranium (or other fissionable material) either by outright purchase or on a rental basis that fully covers at least the average going cost to the government. (The government now pays widely different prices to different producers, depending largely on their costs.)

2. Should get no government-guaranteed price for by-product plutonium. Although the government is now producing plutonium at high cost for weapons, the time is likely to come before long when the armed forces will have no real need for additional plutonium, at least beyond the production of the Atomic Energy Commission. The plutonium would, of course, have value for generating power, but to evaluate that fairly the plant should pay the cost of separating and recovering its by-product plutonium, and use it up in its own power-generating operations.

3. Should be set up on the basis of financing at commercial rates, paying the usual taxes and making a reasonable profit. Since capital costs and obsolescence will be substantially higher than for conventional power plants, these factors are highly important in determining whether or not a nuclear plant is competitive.

4. Should provide a plant location, safety devices, shielding equipment, and provisions for waste disposal substantially as safe as those of the existing atomic piles. While that factor of safety is costly, and may well be higher than needed, as a practical matter it will probably be many years before any political subdivision would feel that it could permit substantial relaxation of present precautions.

Defining commercial power production in this way, most experts will agree that:

1. There will be few, if any, atomic power plants built for purely commercial purposes in this country within 10 years. These would be only at points remote from conventional fuel supplies, and with high load factors. The Shippingport plant, near Pittsburgh, does not qualify under my definition of a commercial plant, since the government is justifiably paying well over half of the total cost.

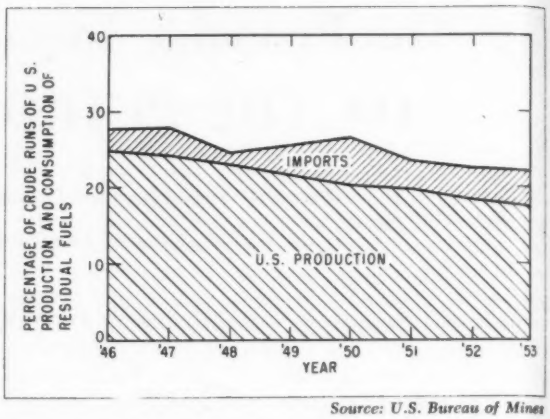
2. Between 10 and 25 years from now (depending partly on technological developments and partly on the trend of prices of competitive fuels), a moderate proportion of the larger commercial power plants built might be built to utilize atomic fuel. No existing plant of reasonable efficiency would be shut down or converted to atomic fuel. As was pointed out by C. C. Whelchel, of Pacific Gas and Electric, during last year's Conference, "... looking to the future, we do not expect nuclear power to supplant power generated by hydro and conventional steam stations. On the contrary, when and as nuclear power becomes economical, we believe it will fit into the nation's ever-growing integrated power systems without displacing then-existing generating facilities or preventing the construction in the future of hydro and conventional steam power plants."*

Competitive Prices

As to the above-mentioned factor of the price of competitive fuels, while it is both expected and hoped that the price of oil and natural gas will increase enough in the next 25 years to make atomic energy more competitive, the author believes the price of coal will be the principal determinant. If oil and gas do go up, undoubtedly John L. Lewis and his successors will combine with economics to make sure that coal does not lag far behind! As a matter of fact, there is a real world shortage of coal today outside of the United States.

If the foregoing is even close to a fair appraisal of the outlook for commercial atomic power, what impact would it have on our industry? To summarize the writer's opinion in a few words, it would seem that the impact on our industry will be negligible

*Atomic Energy Conference of the National Industrial Conference Board.



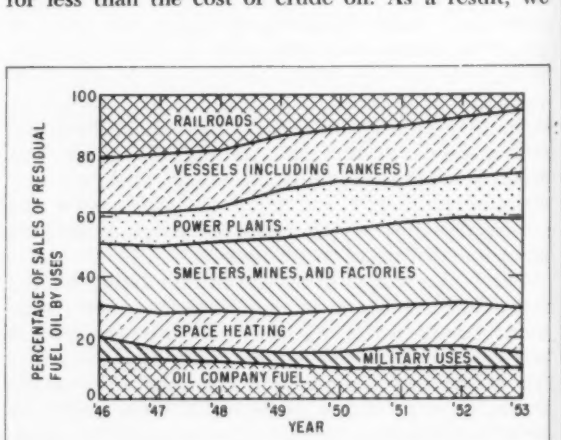
Source: U.S. Bureau of Mines

Fig. 1. Since the end of World War II, the consumption of heavy residual fuel oils in the United States has formed a relatively small part of total petroleum business.

over the next 20 or 25 years. Beyond that, we will welcome its aid in helping to take care of the country's rapidly growing needs for power.

To understand the reasons for this opinion, let us analyze more in detail how such power developments might affect our industry even if speeded up somewhat by subsidies. In the first place, heavy residual fuel oil would be almost the only oil product affected. Fig. 1 shows United States production and consumption of this product in the years since World War II. The difference, of course, represents imports.

As you can see, residual fuel is a relatively small part of our business. While the total volume has trended slowly upward, the percentage has become smaller and smaller. Over the past eight postwar years, our over-all consumption of heavy fuel has gone down from 28 per cent to 22 per cent of the volume of domestic refinery runs. Our production from domestic refinery runs has gone down from 25 per cent to 18 per cent. If the figures were in dollars, the percentage would be still lower. Residual fuel is our least profitable product—the only one selling for less than the cost of crude oil. As a result, we



Source: U.S. Bureau of Mines

Fig. 2. In recent years, of total sales of residual fuel oil, only a small fraction (one-tenth to one-seventh) is used for the generation of electricity in power plants.

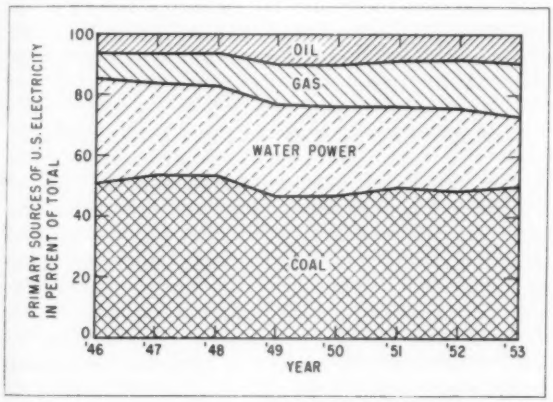
have been steadily reducing our yields and converting more of our residuals into products which are more valuable.

Moreover, only a small part of our residual fuel is used to generate electricity. As you see from Fig. 2, electric power plants take only 10 to 15 per cent of these fuels.

In fact, the total amount of residual fuel used for power generation in the United States in 1953 represented only 3.3 per cent of the total volume of crude run, and here again the percentage would be even smaller if expressed in dollars.

So, even if we lost our central power-plant business entirely during the next 25 years, we would hardly notice it; in fact, we might well lose it to coal long before that, and no tears would be shed. Certainly long before we seriously consider making motor fuel from coal we will be burning more coal in power plants and converting the residual fuel into gasoline, at much lower cost than we can make it from coal.

While a small proportion of our lighter distillate fuels is also used to make power, this is only in very small plants where atomic power would hardly be considered. An exception might be in remote locations where transportation costs may be several times as large as the basic cost of the fuel.



Source: Federal Power Commission

Fig. 3. For its production of power, the electrical industry depends on oil, least of all, for its primary sources of energy.

Natural gas, also, is used to make electricity. Fig. 3 shows the over-all situation as to how the nation's power is generated. Note that in this area coal has held its percentage since World War II, and has, of course, gained greatly in total volume.

While the use of natural gas for power generation has been increasing, it now accounts for only about 18 per cent of the country's total fuel for electric power. Outside of the gas-producing areas it is used today largely because it is available as "dump" gas at low prices during the warmer seasons when the big gas pipe lines from the producing areas would otherwise be operating far below capacity. The availability of dump gas at such low prices will tend to decrease as the older supply contracts expire and more underground storage for gas is put into service near consuming centers. These facilities will make it possible to keep the long pipe lines running nearly full the year round, but storing the excess during the summer in order to have it available for household consumption at higher prices. The use of natural gas for making electricity can be expected to decrease whether or not atomic energy begins to compete, and again no tears will be shed by the gas producer over losing this very low-priced market.

What about fuel oil for ships, which today take about 20 per cent of our residual fuel oil? While some submarines and possibly other special naval vessels will be atomic powered for war service, probably the comparatively high first cost of atomic power plants of moderate size, and the hazards involved will make their use on commercial ships develop even more slowly than in large central power plants. But again, if we should lose the fuel oil business of some of the larger new ships after 20 years or so—what of it?

How about atomic fuel for locomotives, or for cars, buses, and trucks? The only use in land transportation, which has been discussed as even a remote possibility, is in a large locomotive; but even if this should prove to be both safe and economical in normal service (which is doubtful), can you imagine either the railroads or the regulatory authorities being willing to risk a possible wreck of an atomic engine in one of our large cities? A theoretically safe "package" might be designed, but psychological factors would bar it for many, many years.

For cars, trucks, or buses the idea is fantastic. Even supposing people could afford the minimum conceivable cost of tens of thousands of dollars for an atomic engine, we would have to have at least a three-foot concrete dashboard to protect the passengers from dangerous radiations, and front fenders three feet thick to protect the passers-by. For commercial airplanes, too, the shielding problems seem to constitute an almost insuperable bar, though the greater distance of the pilot from the power plant would help to some extent.

In this connection, mention should probably be made of the paper presented by C. C. Furnas at the September, 1954, meeting of the American Chemical Society. Some of the editorial comments on his paper made Dr. Furnas sound quite optimistic about the possibility that lightweight shielding devices could be developed. Reference to the actual paper shows that while Dr. Furnas urged research along such lines, he was not optimistic and indicated that the physicists are quite pessimistic. It is fair to say that the problem of lightweight shielding against the gamma part of the radiation is in almost the same class as the problem of shielding against gravity. So far as impact on the oil industry is concerned, it is the project "least likely to succeed."

Impact on Automobile Business

In discussing the impact of atomic energy on the automobile business, we can rule out engines using atomic fuel, but there are other possibillities we ought to consider. Might not cheap electricity from atomic power plants be used to charge some new kind of highly efficient storage batteries for electric automobiles?

In the first place, even if atomic power plants do become commercially competitive, there is very little likelihood that the power will be cheap by present standards; in the second place, further radical improvements in storage batteries do not appear to be in sight despite many years of research. Furthermore, even solving these problems would probably not affect the gasoline business very much.

Let us review some facts about automobiles. One important point is that gasoline is a relatively small part of the cost of driving a car. On the average, gasoline accounts for less than one-quarter of the total cost of the transportation. If we base our calculations on the price of gasoline (ex tax) at the refinery gate, we find that the fuel cost of the energy represents only about one-eighth of the total cost. Any competing source of mobile energy will have a hard time beating such figures. While the refinery price figure omits the relatively large factors of gasoline taxes and distribution costs, the latter would certainly not be less for storage battery charging and distribution, and you can be sure that the governmental bodies would not long neglect to tax the competition if it became important.

Incidentally, gasoline prices, ex taxes, are about the same as they were in 1926, whereas automobiles cost over twice as much. They are, to be sure, greatly improved, but so is modern gasoline, which, thanks largely to improved antiknock rating, will do 60 per cent more useful work per gallon in a modern high-compression engine.

Another important point is that the gasoline engine is a very low-cost engine. In a small car costing around $2,000, the engine represents only $300 of that total. The designer of a competitive type of engine or motor does not have a great deal of money to play with.

Most importantly of all, however, the buyer of gasoline is not looking primarily for cheap British thermal units. Instead, he demands in his car things like fast acceleration, agility in traffic, driving comfort, and the other qualities that come under the general heading of "performance."

The electric car lost out once in the competition with the gasoline car when gasoline engines were less efficient and power requirements lower. Atomic energy seems unlikely to put it back in the race.

There is, of course, the remote possibility of revolutionary new devices being discovered which would convert atomic energy directly to electricity, but this seems highly unlikely. At the second of these conferences* held a year ago, Walter Zinn said he had seen no such scheme that seemed practical. Here again the low cost of the gasoline engine and the low cost of operating it seem practically certain to hold the business for the oil industry.

Space Heating

After the various transportation uses, the next most important use of oil products is in space heating. Is there any chance that atomic energy will replace our distillate fuels, used mainly in home heating? In this field, the customer comes much closer to shopping for mere B.T.U.'s than when he buys gasoline.

Atomic energy for such uses seems to be ruled out by its usual handicaps: the need for heavy shielding, the problem of handling radioactive wastes, and the high cost of the equipment. The high equipment cost is pointed up by the estimates made in connection with the Army Package Power Reactor, designed to generate 1,700 kilowatts. Lawrence R. Hafstad said the probable cost would be "considerably less than $8,000,000," and there were some "guesstimates" as low as $5,000,000. Even this figure, however, would be 10 times the cost of an equivalent Diesel unit. For generating electric power or for producing heat, atomic energy would seem to be attractive only in locations like northern Greenland, where Diesel fuel may cost $1.00 a gallon instead of the normal $0.12 or $0.13.

In other remote locations, particularly where the climate is not too cold, electricity from atoms might prove economical for driving heat pumps. These are the devices that take low-level heat from outdoors and convert it to the higher-level heat needed indoors. It is possible that some day the heat pump will become a substantial competitor of the oil industry in certain areas. But if it does, it will for many years use electricity generated from coal rather than from atomic energy.

Atomic Energy Will Help the Oil Industry

The writer has indicated the reasons why he believes no important phase of the oil business will be adversely affected by atomic energy in the foreseeable future. On the contrary, atomic energy is likely to help us. So long as there exists danger of an atomic war, decentralization will become the pattern for industry and for the population. The resulting increase in travel will be largely powered by oil, and mainly over roads built with our asphalt. New construction taking place in outlying districts will use oil-powered bulldozers and certain asphalt-based building materials.

The enormously greater power of atomic bombs will cut down bomber fuel requirements if we do have a war, but that would mean a welcome lessening of the oil industry's peak load in wartime, and would lessen the need for wartime rationing of our products—even assuming the next war lasted long enough to require it.

Turning to a radically different benefit, the oil business—like any others using science—will benefit from the radioisotopes used as tracers in many lines of research. Our products are more complicated than most chemical products and so we are in an unusually favorable position to use the information these tracers make possible. A paper at this conference last year described still another use of these tracers, in studies of wear in automotive engines. For some time we have been using radioactive devices for logging oil wells. Radioactive markers are used to indicate instantly the interface between different products being pumped through our product pipe lines; and the industry's active research laboratories

(*Concluded on page 162*)

*Atomic Energy Conference of the National Industrial Conference Board.

Maturity through Student Counseling—I

Factors Affecting the Maturity of College Students Are Discussed as Precursor for Outline of a Counseling Program Established at M.I.T.

By DANA L. FARNSWORTH

To those of us engaged in the profession of education it is profitable occasionally to sit back and look as objectively as possible at the basic goals toward which we strive. Quite specifically, what are we attempting to do with our college students? If the attainment of maturity is one of the goals, how can it be attained, and what is it, anyway?

Stated in the simplest terms, the chief expectations of the college graduate are that he shall be able to read, write, speak, and listen in order that there be free communication with others. Since thinking is not effective without command of subject matter, he should be expected to be firmly grounded in his knowledge of at least one large body of subject matter, together with some skill in relating that familiar area with other bodies of knowledge with which he is less familiar. In college he has the opportunity of forming a set of habits that will set the tone of his living and thinking for the rest of his life. Likewise, it is the ideal place for the development of interest, of enthusiasm, and of a sense of purpose. If the educational experience has been a wholesome one, the student will have obtained the will to learn, to serve, to exercise humility, and to try to understand.

However, there are many pitfalls in the way of becoming this mature person. Somehow the student must learn how to conduct himself in the midst of perplexity and uncertainty without feeling so insecure as to paralyze action. He must learn to disagree heartily with his neighbor without, on that account, losing respect for his opinion or integrity. He must learn how to deal with material things along purely scientific lines and at the same time develop skill in dealing with the abstract, the apparently irrational and the emotional. He needs to distinguish between sentiment and sentimentality.

All too often education has been thought of as the development of the power of rational thinking. This has resulted, as Dean Sperry of Harvard has said, in the unhappy fact that "in the modern world our specialized skills have outrun our total wisdom." Knowledge and intelligence in themselves have only an indirect relation to the moral conduct of an individual. It seems fairly obvious to many of us that our traditional concepts of education need a rather thorough overhauling in order that greater emphasis be placed on the attainment of total wisdom, although at the same time we cannot afford to relax standards of accomplishment that now prevail in specialized fields. In fact they probably need to be increased, possibly with some change in emphasis.

While thinking about the ideal college graduate, it might be helpful to reflect briefly on some of the community influences that have been brought to bear on this student, together with a few of the basic, urgent problems that he faces as a citizen.

In the attempts to develop some sort of maturity in college a great many forces in our present society seem at times to act in the opposite direction. Among these are the tendency to extreme materialism, suspicion of all things intellectual, the presence of great numbers of purveyors of suspicion, hate and discord, the tendency of our chief agencies of communication to emphasize drama and excitement rather than some of the more sober virtues, and our inconsistent social and community customs.

In a thousand and one ways the young person is led to believe that it is the results that count, that success is equivalent to wealth, or that security is measured in terms of pension plans or money in the bank rather than in a strong and just society. Conspicuous consumption, to use Veblen's phrase, is honored all too often over inconspicuous service. Too many citizens say, "What is there in it for me?" rather than, "In what way might I help?"

Likewise the problem of "staying educated" is infinitely more difficult in some communities than in others. Pleasure in good conversation, toleration of dissenting opinion, high tastes in music, literature, art and the theatre, and similar qualities which many of us consider as the very essence of the good life are frowned upon in many communities with which the writer is familiar, and the persons who dare show their pleasure in them are criticized as being intellectual snobs, though the phrases used are usually a bit more expressive. In place of these activities first priority is given to bridge, talk about sports, and the less desirable aspects of politics, and criticism or resentment of those who try hard to raise community standards of taste.

Those who spread hate and discord are numerous indeed, and they are frequently not recognized because they operate under cloaks of eminent respectability. One has only to recall the professional patriots, the ministers who promote anti-Semitism and anti-negro sentiment, and the fanatics who operate in areas of public controversy, to recognize their potentialities for disturbing our peace of mind. Areas

which seem to attract fanatical thinking include antivivisection, fads in food, impassioned defenses of specific causes or cures of cancer, fluoridization of water (just as it used to be pasteurization of milk), schools of education, and recently in Brookline, Mass., at least, cursive versus manuscript writing. Mix these subjects with the current confusion about Communism and the results are indeed deplorable at times.

Last but not least, there is the influence of our chief agencies of communication — advertising, radio, television, and newspapers or magazines. Without these agencies our lives would be poor indeed, and with them our greatest benefits and pleasures are promoted. Yet common to all of them are certain tendencies of serious import so far as the emotions of all of us are concerned.

First there is the sheer number and force of impact of continued strong stimulation, repeated over and over with varying emphases. The actual facts of which we must know to be intelligent citizens are desperate enough. Add to this the appeal to pride, envy, and jealousy which is used by the skillful advertising agency to make us dissatisfied with our lot, the high tension of some radio announcers who seem compelled by some strong force to act and speak as if they were always in a continuous state of high excitement, the concept that it is all right to be rude to people by invading their privacy so long as it will make them remember a certain product, and the distortion of news to make it salable, and you have a total bulk of confusing, frustrating stimuli that does tremendous damage. Frequently public demands are exploited, rather than satisfied, as some recent writer has so well expressed it. These agencies have no permanent vested interest in mediocrity or worse that could not be replaced by a vested interest in something far better, if only we knew how to raise the tastes of the community generally. Sir Richard Livingstone has said that the way to make a person truly critical is to expose him to the first rate until the inferior ceases to attract. But how is the vicious cycle to be broken, if not by the daring and imagination of our policy makers in these fields?

Now if we add to these hindrances to consistent thinking those of giving untrue explanations of factual matters to keep children from asking so many questions, our total disregard of speed signs and regulations (and the excessively restrictive limits often posted by officials as a means of increasing their bargaining power), rationalizing the dishonest acts of politicians with whom we agree in many respects, the professionalization of athletics in high schools and colleges, and dozens of others which you can add from your own thinking, one might wonder how a young person could ever evolve a satisfactory code of ethics from the examples shown him. The idealized ethics, of which he gets fleeting glimpses on Sundays, have great difficulty when in conflict with actions the rest of the week.

In the college itself there are apt to be a number of customs, forces or tendencies which tend to detract from a proper emphasis on the intellectual properties for which a college exists. When fraternities are too strong, it is an easy matter for loyalties to them to be greater than loyalty to the purposes of the institution itself. The attitudes of alumni are usually helpful but sometimes harmful. Their behavior when they return for alumni reunions does not always set the best possible example for students to emulate. Some customs of students, such as their demonstrations of school spirit, may at times get somewhat out of bounds. Hazing, especially when it pits one group against another, develops a kind of spirit and hostility which is later expressed as power struggles in larger situations, or even in war between nations. Systems of discipline and probation may appear to be exercised with a basically punitive philosophy, thus creating undue antagonism on the part of many students. Pressures for comformity in behavior and thought are often great. Some believe that these pressures are greater in small colleges while others have the opposite view. A large deviation from a supposed norm is usually tolerated more readily than a minor variation. Medical excuse systems, which seem so necessary to most schools that have a Medical Department, may, if abused, constitute direct vehicles for teaching students to exaggerate illnesses for the secondary gains they derive from them. Any school that subsidizes athletes or gives special favors surreptitiously to any group is giving excellent training for ward politicians later on. Anyone who studies college campuses soon finds that they have personalities as distinct as those of individuals. Whether the basic impact of this total college personality is of a nature that encourages the chief purposes for which the college exists, or serves to emphasize the secondary social and prestige values, depends to a very large extent on the philosophy of the college administration and alumni. All too often, the faculty is less influential in promoting lasting respect for intellectual activity than its central position would suggest.

In our society competitiveness has become so overemphasized as to be almost an end in itself. Healthy competition is one thing, but a chronic attitude of competitiveness is quite different, at least in its effect. Instead of working at a high level, consistent with one's own abilities, a student feels impelled to lead his class for the sake of excelling others. The son feels unworthy unless he can make a better record than his father made. Thus we may have the illogical situation of a person doing good work but deprived of inner satisfaction from it because of current attitudes regarding competitiveness. Constant comparison with outside situations in which quantity is valued over quality leads to overemphasis on grades, too much time spent on too many extracurricular activities, as well as other practices which detract from proper emphasis on desirable intellectual activities. Some students tend to relate all their performances to those of others, never to their own previous accomplishments.

Perhaps it would now be helpful to look at some of the fundamental questions which the young student must consider and solve if he is to live the kind of life which he may enjoy and which his parents may contemplate with satisfaction. Among these are sheer survival, adjusting to a densely populated country, better methods of channeling hate and aggression into nondestructive channels, sup-

pression of unfair discrimination and prejudice, excessive nationalism, and lack of faith in anything.

We now live in a world in which the means of destruction have far outdistanced the means of self-control. Our society is so organized that it will spend billions of dollars for weapons of destruction but is much less likely to support efforts to develop self-control.

In the next generation our people must still further accommodate themselves to living in a densely populated country. Every morning in this country there are 7,000 more persons for breakfast than on the day previously. There is a birth every eight seconds, a death every 21 seconds. Two-thirds of our population live in urban areas.

Living in closely knit communities means that the methods of channeling hatred and aggression into forms that will not be destructive of society must be ever more effective. The causes of juvenile delinquency must be sought carefully and scientifically, and the solutions worked out in terms of social betterment rather than by more punishment and larger prisons. The portrayal of crime, brutal lust – and all such forms of unacceptable behavior – in comic books, on radio and television programs, and elsewhere, calls for action in terms of public opinion, rather than by censorship by individuals or groups incapable of such discrimination.

Discrimination and prejudice are forms of hostility which also cause us much trouble both at home and abroad. Fortunately, these two characteristics have to be taught, in contrast with hatred and aggression with which all of us seem to be equipped at birth. Unfair discrimination on the basis of personal characteristics beyond the control or influence of the individual is harmful, both to the one who practices it, and to the recipient. Those of us who have never been subjected to anything but relatively benign forms of discrimination have no real conception as to how severe the traumatic effect of being barred from hotels, clubs, certain neighborhoods, schools or churches may be.

Excessive nationalism is an age-old problem, chronic in Europe, now excessively prominent with us. One has only to read the letters-to-the-editor columns to feel how deep and violent are the undercurrents of hate and violence stirred up by misguided patriots. As Ralph Barton Perry has stated so effectively, "Patriotism is one of the loftiest and at the same time one of the most dangerous emotions of which mankind is capable. The accusation of disloyalty needs no other evidence than a hesitation to cheer or shout with the crowd, and needs no other penalty than to be labeled an outcast. As patriotism becomes protective coloration by which the individual's behavior in other respects escapes notice, so the dissenter, however slight his deviation, becomes a marked man from whom others withdraw themselves. Patriotism is converted into the persecution of those who are deemed nonpatriotic by the patriots. The more passionate the patriotism, the closer the scrutiny and the quicker the suspicion."[1]

1. Perry, Ralph B., *The Citizen Decides*, pages 14–17 (Bloomington: Indiana University Press, 1951).

Harold M. Lambert

The problem of a lack of faith or belief in anything is much more subtle than the preceding difficulties, and its solution will require the most thoughtful effort of which we are capable. By its very nature democracy is incompatible with fanaticism but it is virtually synonymous with a deep confidence in human beings, respect of decency and moral values, and the right to be free in thought and action, so long as these do not harm others. Here again we are right back with the necessity of learning how to live in a crowded world where no freedom can be achieved without assuming responsibility.

It is even more true now than it was in 1932 when Ortega y Gasset wrote that, "We live at a time when man believes himself fabulously capable of creation, but he does not know what to create. Lord of all things, he is not lord of himself. He feels lost amid his own abundance. With more means at his disposal, more knowledge, more technique than ever, it turns out that the world today goes the same way as the worst of worlds that have been; it simply drifts. Hence the strange combination of a sense of power and a sense of insecurity which has taken up its abode in the soul of modern man."[2]

From all this complex welter of opposing and interconnecting forces we hope that mature people will develop. The mature person is one who enjoys full and satisfying participation in all that life has to offer. He feels comfortable about himself and feels right about other people. He is able to meet the demands of life. He guides his emotional expression

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2. Ortega y Gasset, José, *The Revolt of the Masses*, pages 31–32 (New York: W. W. Norton and Company, Inc. [Mentor Books], 1932).

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Surnames Familiar

EMERGING from the registration statistics of the freshman class, which enrolled at the Institute in the fall of 1954, are 27 surnames which ring familiarly because they appear on the roster of M.I.T. Alumni. Sons or daughters of Alumni, whose names appear in the following columns, became members of the largest (final count 995) freshman class ever to register at the Institute. A welcome is extended to this group of first-year students who, by enrollment at the Institute, and by repetition of parental choice of about a quarter of a century ago, have indicated their belief in an engineering training of high quality.

Student	*Parent*
William G. L. Bateman	Glen L. Bateman, '25
Walter R. Blake	Kenneth B. Blake, '13
James H. Brown	Harold J. Brown, '30
Patricia A. Clogher	Eaton J. Clogher, '18
Donald C. Dolben	Alfred H. Dolben, '26
Donald T. Greene	Charles R. Greene, '29
Carlyle L. Helber, Jr.	Carlyle L. Helber, '26
Malcolm K. Hubbard	Malcolm M. Hubbard, '29
Alan C. Hurkamp	Charles H. Hurkamp, '27
Helen A. Johnson	Algot J. Johnson, '21
Frederick W. Kressman, 3d	Frederick W. Kressman, Jr., '33
William N. Latham	Allen Latham, Jr., '30
Ralph E. Manchester, Jr.	Ralph E. Manchester, '29
Courtenay D. Marshall	Courtenay D. Marshall, '33
Calvin J. Morse	Winslow C. Morse, '22
Joanna M. Muckenhoupt	Carl F. Muckenhoupt, '29
Thomas H. O'Connor	Thomas H. O'Connor, '30
Eliot J. Pearlman	Samuel Pearlman, '27
Allen R. Philippe	Robert R. Philippe, '29
Robert A. Phinney	Robert M. Phinney, '04
John H. Ramsey	John P. Ramsey, '25
Joseph Ranger	Casper Ranger, 2d, '25
Neal H. Rosenthal	Barnet L. Rosenthal, '30
David L. Schweizer	F. David Schweizer, '31
Jonathan D. Senzer	Sidney Senzer, '21
Charles C. Vicary	James W. Vicary, '33
Richard H. Wick	Richard M. Wick, '25

Shapiro, Associate Dean

ELI SHAPIRO, Professor of Finance since 1952, has been appointed associate dean of the Institute's School of Industrial Management, according to an announcement by James R. Killian, Jr., '26, President. Dr. Shapiro is widely known as a teacher and for research in such fields as corporate finance, consumer credit, and the interrelation of business financial policy and the general economy.

Professor Shapiro received the degree of bachelor of arts from Brooklyn College in 1936, and the degrees of master of arts and doctor of philosophy from Columbia University in 1937 and 1945. From 1936 to 1941 Dr. Shapiro was an instructor in economics at Brooklyn College. During this same period he also served as research associate, Financial Research Program of the National Bureau of Economic Research (1938–1939); consultant to the Financial Research Program of the National Bureau of Economic Research (1938–1942); economic analyst in the Division of Monetary Research of the Treasury Department (1941–1942); and economist for the research division of the Office of Price Administration (1941–1942).

M.I.T. Photo

Professor Eli Shapiro
Associate Dean, M.I.T. School of Industrial Management

On active duty with the United States Navy from July, 1942, until February, 1946, Dr. Shapiro received commendations for his work in scheduling tanker requirements for the Pacific Theater and for statistical studies for the Navy Manpower Survey.

Following his war service, Dr. Shapiro returned to Brooklyn College as assistant professor of economics. In 1946 he was appointed assistant professor of finance at the School of Business of the University of Chicago, where he was named associate professor of finance in 1948 and professor in 1952.

Dr. Shapiro has written extensively for professional periodicals on banking and finance, and his books include *Development of Wisconsin Credit Union Movement* and *Money and Banking*, which he wrote with W. H. Steiner.

1955 Midwinter Meeting

THE Midwinter Meeting for Technology Alumni in Metropolitan Boston will take place on Thursday, February 3, at Walker Memorial, according to Frederick B. Grant, '39, chairman of the Midwinter Meeting Committee.

Speaking for M.I.T. at this important annual event will be Julius A. Stratton, '23, Vice-president and Provost of the Institute. According to Mr. Grant, there will be a repetition of last year's successful pattern of talks on technology by three firms in Greater Boston who will take part in the program. Heading each of these firms, incidentally, is a Technology Alumnus. The concerns which will take part in the Midwinter Meeting are: Photon, Inc., engaged in photoelectric typesetting machines; High Voltage Engineering Corporation, producer of electrostatic generators of the Van de Graaff-type for commercial use; and Tracerlab, active in the development of detectors for radioactive materials.

Council Opens New Season

THE 305th meeting of the Alumni Council – and the first for the 1954–1955 season – was held on Monday, October 25, with the Association's new President, Hugh S. Ferguson, '23, presiding. After the usual dinner at the Faculty Club, Mr. Ferguson opened the meeting, attended by 161 members, by introducing: C. Richard Soderberg, '20, Dean of the School of Engineering; H. E. Lobdell, '17, Executive Vice-president of the Association; Paul A. Heymans, '23, President of the M.I.T. Club of Belgium, Walter Heymans, his brother, and Jacques Heymans, his son; William H. McTigue, Jr., '54, Captain of last year's 150-pound crew; and Godfrey L. Cabot, '81.

As Secretary, Donald P. Severance, '38, reported that changes had been made in class affiliation for 13 Alumni, presented nominations for Departmental Visiting Committees of the Corporation, and asked for an affirmative vote for new representatives of local associations, as well as the Council membership.

It was reported that the M.I.T. Club of Spain, organized on August 27, 1954, in Madrid, has been recognized as the 92d local association. During the summer months, visits to M.I.T. clubs in Paris, Brussels, Barcelona, and Madrid were made by Mr. Lobdell; in addition, 11 M.I.T. clubs in the United States were visited by Hamilton Herman, '43, Harl P. Aldrich, Jr., '47, Horace S. Ford, Mr. Severance, Rolf Eliassen, '32 and Bruce F. Kingsbury, 2–44.

As Treasurer, Mr. Severance reported that Alumni Day, 1954, had been conducted with a net operating loss of $4,640 compared to a loss of $3,500 for Alumni Day, 1953. Total expenses of the Alumni Association for the fiscal year ending June 30, 1954, amounted to $43,586 as against the budgeted figure of $41,097. Despite continually increasing production costs, for more than 25 consecutive years, income for The Review exceeded expenses and this year's net gain was used to make up the Association's operating deficit of $2,480 and to add $4,740 to the 1955 Alumni Fund. The previously authorized temporary withdrawals from the Alumni Association Reserve Fund have been reduced by the amount of $939, which represents net income from the sale of M.I.T. chairs, records, and glassware.

As chairman of the Alumni Fund Board for the current year, Theodore T. Miller, '22, announced that the Board had agreed to devote the entire proceeds of the 1955 Alumni Fund toward a $7,000,000 objective, which fund is to be used to build and endow the Karl Taylor Compton Laboratories, including a nuclear reactor. While the Alumni Fund Board has promised no minimum amount as its share toward this memorial, the Board has set for itself the goal of doubling the normal number of contributors and increasing by 50 per cent average alumni contributions.

James B. McMillin, '43, head crew coach, was then called upon to introduce Jack H. Frailey, 10–44, coach of the 150-pound championship crew which won the Thames Challenge Cup at the Royal Henley Regatta last July, as already recorded in the July and November issues of The Review. Mr. Frailey told of the experiences which the Technology team encountered in training, on their trip to England, and during the Regatta, and emphasized his remarks by showing a 15-minute color motion picture film of several of the Henley races.

Final speaker of the evening was Julius A. Stratton, '23, Provost, who spoke on trends having a bearing on the future composition of the Association. A fairly extensive summary of Dr. Stratton's remarks appeared on page 80 of the December, 1954, issue of The Review and, accordingly, will not be abstracted here.

Corrective Formulas

THE Visiting Committee on the Department of Chemistry* held an all-day meeting in the Moore Room at the Institute on February 28, 1954. The report of the Visiting Committee, reviewed at the June 11, 1954, meeting of the M.I.T. Corporation and the September 17, 1954, meeting of the Executive Committee, was released for publication in The Review on September 29. A summary is presented in the following paragraphs.

At the morning session about 20 representatives of the Department were present and, after introductory remarks by Arthur C. Cope, in charge of the Department, six instructors in chemistry, all of them in their first year at the Institute, made brief presentations of their teaching and research programs. The Committee found all of these reports interesting and stimulating, and were happy to find so much enthusiasm and ability in the younger members of the Department.

In the discussion following the presentations, it developed that the six young instructors were spending about half their time teaching, and the remaining half pursuing their own research interests, which seemed to the Visiting Committee, as it did to the young men themselves, a proper distribution of effort.

The Committee then heard a report from Clark C. Stephenson, Associate Professor of Chemistry, relating to the effect on the first-year chemistry curriculum of a reduction in contact hours from seven to six.

*Members of this Committee for 1953–1954 were: Crawford H. Greenewalt, '22, chairman, Pierre F. Lavedan, '20, Edwin D. Ryer, '20, John M. Gaines, '26, John G. Kirkwood, '29, M. Gilbert Burford, William M. Holaway, and Paul L. Salzberg.

The Visiting Committee was sympathetic with the desire of the faculty so to arrange the freshman curriculum to allow students more free time. The Department of Chemistry has surveyed the situation in other colleges and universities and reported that seven hours is no more than average for first-year chemistry courses, and six would be well below par.

However, the Committee was unanimously of the opinion that the curriculum used in past years, embracing two hours of lecture, two hours of recitation, and three hours of laboratory, was at a practical minimum for proper instruction, at M.I.T. standards.

The afternoon was devoted to a general discussion of the problems of the Department. There was also some discussion of ways and means of making chemistry more attractive as a vocation, and it was the feeling of the Visiting Committee that much could be done in this direction. Aside from any action which might be taken at the Institute in connection with its own chemistry curriculum, the Committee felt that much of the burden must ultimately rest on the teaching of science in secondary schools, a problem which the Institute recognizes and is studying actively.

Finally, the Committee approved for the Department of Chemistry, the Institute's present policy of private consulting, in the belief that acceptance by professors and instructors of outside consulting adds both vitality and understanding to their work.

New Course in Shipping

THE first students have registered this fall for a new five-year program at the Institute which prepares for careers in management for the shipping and shipbuilding industry. Five years of study in the Department of Naval Architecture and Marine Engineering will lead, under the new course, to two degrees awarded simultaneously: the bachelor of science in Naval Architecture and Marine Engineering and a new master's degree, the master of science in shipping and shipbuilding management.

The new course in shipping and shipbuilding management and the new master's degree, to which it leads, were approved by the M.I.T. Faculty last spring; the new degree is expected to be awarded for the first time in the commencement exercises of June, 1955, according to Professor Laurens Troost, Head of the Department.

"The primary objective of the new curriculum," explained Professor Troost, "is to provide effective academic preparation for careers as members of technical, supervisory and management groups in marine transportation, shipbuilding, and supporting technical activities. The new course provides significant competence in the areas of management, administration, and economics in addition to technical competence in naval architecture and marine engineering."

Students in the fourth and fifth years of the new curriculum in shipping and shipbuilding management study extensively in M.I.T.'s School of Industrial Management and in the Department of Economics and Social Science. Requirements for the final year include a thesis in a subject which integrates the shipping or shipbuilding field with economics or management.

Civil Engineering Survey

THE Visiting Committee on the Department of Civil and Sanitary engineering* held well-attended meetings at the Institute on March 1 and 2, 1954. A report of the meetings was released for publication in The Review on September 29, and a condensation is presented in the following paragraphs.

On the morning of March 1, the Committee was joined by Edward L. Cochrane, '20, Dean of the School of Engineering [now Vice-president for Industrial and Governmental Relations], in conferring with Professor John B. Wilbur, '26, in charge of the Department, on departmental matters. Following this conference a Corporation seminar was attended, at which Dean Cochrane, with the assistance of a number of younger professors in the School of Engineering, discussed several phases of engineering that are so broad in scope that they cut across departmental boundaries. In the afternoon the laboratories of the Department were visited. On March 2, the Committee conferred with the various divisions of the Department. James R. Killian, Jr., '26, President, Julius A. Stratton, '23, Provost, and Walter H. Gale, '29, Secretary of the Institute, then joined the Committee and the academic staff of the Department at a luncheon in the Faculty Club, and then the Committee held a brief final session there.

Last year's recommendation of this Committee that the summer surveying camp at East Machias be discontinued having been approved by the Corporation, the Department now faces certain problems that arise because required work in surveying will henceforth be taught in Greater Boston during the regular school year. Briefly, these problems are threefold: (1) the need of sufficient man power to teach surveying field work; (2) the determination of the amount of time to be devoted to surveying in the new curriculum; and (3) the content of the revised subjects that are to be offered. With respect to man power, the need of increasing the staff somewhat in the Division of Transportation and Surveying should be recognized. The proposal to devote 24 units of work to surveying in the new Civil Engineering curriculum appears to be reasonable. It is believed, however, that the reduction of time spent on surveying to eight units in the new curriculum in Building Engineering and Construction cuts too deeply into the time available for this subject.

The content of the three revised surveying subjects for Civil Engineering, as tentatively outlined by Herman J. Shea, '33, Associate Professor of Surveying, appears to be excellent, and in keeping with this Committee's previous recommendation that these subjects should be designed to emphasize the fundamentals of the broad field of civil engineering measurements. It is to be regretted that thus far the new curriculum in Building Engineering and Construction includes only the first of these three subjects; the inclusion of a second term of surveying seems highly desirable.

The studies recently conducted by the Department to avoid duplication of substantially equivalent sub-

*Members of this Committee for 1953–1954 were: Thomas C. Desmond, '09, chairman, William J. Orchard, '11, Eugene L. MacDonald, '13, Howard H. McClintic, Jr., '19, Alfred T. Glassett, '20, John M. Kyle, George R. Rich, and Henry R. Shepley.

jects in the curriculums for Civil Engineering and for Building Engineering and Construction are to be commended. So far, this effort has been directed toward undergraduate subjects; it is understood that the study will be extended to include graduate subjects, and this might well be done.

This Committee believes, however, that such studies, though desirable, should actually be only preliminary moves toward a more complete consolidation of Civil Engineering and Building Engineering and Construction. Questions may well be raised as to whether the considerable duplication between these two courses does not arise primarily because Building Engineering and Construction is actually a part of Civil Engineering, and whether the degree of specialization involved in a separate curriculum dealing with buildings only, does not violate the goal of breadth through fundamentals that should typify the education of professional engineers.

Last year this Committee stressed the importance of soil mechanics to the civil engineering program, and pointed out that it would be desirable to expand the graduate program in this area so that a graduate student could elect a year's program of studies centered on soil mechanics and its related subjects. The Committee is pleased to learn of the progress that has been made in this direction during the past year by Donald W. Taylor, '34, Associate Professor of Soil Mechanics, and his associates, and to find that such a program will be offered in the fall of 1954.

For the past several years this Committee has recommended that substantial special appropriations be made to complete the basic equipment for instruction and research in the new Hydrodynamics Laboratory. While these recommendations have been received sympathetically, it has not as yet been possible to supply all the funds that are required to satisfy the minimum basic needs of the laboratory as outlined by Professor Arthur T. Ippen.

The Committee is impressed by both the quality and scope of the creative work of this Department, as typified in particular by its active and diversified research programs, and sincerely hopes that these activities will continue to flourish and not become curtailed because of any diminution of financial support from governmental and industrial sponsors. The results of these programs of research, as, for example, the contributions of the Structural Division of our country's ability to design and build structures capable of resisting atomic bombs, or the knowledge regarding the treatment of radioactive wastes that is being developed by the Sanitary Division, may well prove to be among the important civil engineering contributions of our time.

Physics Scholarship

A SCHOLARSHIP fund of $5,000, the income of which is to be available to an undergraduate in the Department of Physics, has been established at M.I.T. in memory of Irving Shaknov, '43, who was killed in action on May 14, 1952, while serving in Korea for the Operations Evaluation Group, which M.I.T. operates for the U.S. Navy. The first award of these memorial funds will be made during 1955, according to Thomas P. Pitré, Director of Student Aid at M.I.T., who announced the scholarship.

Dr. Shaknov was the son of Mr. and Mrs. William M. Shaknov of Dorchester; Mr. Shaknov is a member of the technical staff at M.I.T.'s Division of Defense Laboratories.

At a recent ceremony at the headquarters of the Operations Evaluation Group in Washington, Rear Admiral Walter G. Schindler, Assistant Chief of Naval Operations, reported that Dr. Shaknov was killed "when the plane in which he was riding to obtain information on interdiction operations crashed behind the Communist lines in Korea."

Earlier, it was pointed out, the Shaknov family, although informed that Dr. Shaknov was missing in action, were not allowed to divulge that fact to even close friends and relatives. "They were compelled," said Jacinto Steinhardt, Director of the Operations Evaluation Group, "to make others believe that they were in close touch with Dr. Shaknov at all times, a thing which imposed much suffering and heartache on the family. This secrecy was necessary," Dr. Steinhardt explained, "because if Dr. Shaknov's status with O.E.G. were revealed even indirectly to the enemy – and if he were being held by the Communists as a prisoner of war – he would have been subject to interrogation."

Dr. Shaknov was posthumously awarded the Medal of Freedom by the Secretary of the Navy on May 7, 1954. During World War II, while serving as an officer in the Army, he was awarded the Bronze Star Medal for heroic action in saving the life of a fellow officer.

At the ceremony in Washington, the Operations Evaluation Group unveiled a portrait of Dr. Shaknov by Jeff T. Boswell which now hangs in O.E.G. headquarters in the Pentagon. M.I.T. was represented at the services by F. Leroy Foster, '25, Associate Director of the Division of Industrial Coöperation.

Ernest F. Langley: 1874-1954

ERNEST F. LANGLEY, Professor of French, Emeritus, who headed the Department of Modern Languages for 14 years until his retirement in 1944, died in St. Louis on September 22, 1954. He was 80 years old.

Widely honored as a student of Romance languages, Professor Langley received the degree of bachelor of arts in his native Toronto, and the degrees of master of arts and doctor of philosophy at Harvard University. His career as an educator was supplemented by extensive graduate study at European universities, and he became a naturalized American citizen in 1920.

Professor Langley's first teaching appointment was at Dartmouth College, where he served as instructor in French and assistant professor of Romance languages for eight years. In 1910 he joined the M.I.T. Faculty as professor of French, and until 1926 had charge of instruction in Romance languages. The Department of Romance Languages, renamed Department of Modern Languages in 1930, was headed by Professor Langley from 1926 until his retirement. He remained at the Institute until 1945 as lecturer in the Department.

November Council Meeting

IN the nonbusiness portion of the 306th meeting of the Alumni Council on November 29, 1954, Jerome C. Hunsaker, '12, Professor of Aeronautical Engineering, Emeritus, discussed "American Use of the Air" and Professor Douglas M. McGregor spoke on "Current Changes in Management Philosophy." Hugh S. Ferguson, '23, President of the Association, presided at the dinner meeting at the Faculty Club at which 175 members and guests were present.

As matters of business, Donald P. Severance, '38, Secretary, announced changes in class affiliation for 10 Alumni, and that between October 14 and November 19, a dozen M.I.T. clubs from Albuquerque to Worcester had been visited by 12 members of the Institute's staff. Regional conferences to be held in Dallas on January 29, and in Cleveland on February 26 were also announced.

Alumni Day, 1955, will be held on June 13. Avery H. Stanton, '25, will be chairman and Donald W. Kitchin, '19, will serve as deputy chairman. Committee chairmen for this event are: *Banquet* – Gilbert M. Roddy, '31; *Luncheon* – Alan W. Burke, '20; *Ladies'* – Mrs. E. P. Brooks; *Registration* – Wolcott A. Hokanson; *Conference* – Edward L. Cochrane, '20.

Plans for the Metropolitan Boston Midwinter Meeting of Alumni were announced by Frederick B. Grant, '39, chairman, as given in a separate article on page 147, and, as Director of the Alumni Fund, Henry B. Kane, '24, urged all Alumni to take advantage of the opportunity to help build the Karl Taylor Compton Laboratories as a memorial to the Institute's late chairman of the Corporation.

In speaking on "American Use of the Air" Professor Hunsaker took opportunity to comment on the many contributions to aviation made by Technology graduates. Among the M.I.T. Alumni who took part in pioneering developments were: the late Virginius E. Clark, '15, who developed the curved thin wing into the thick, structurally sound, wing section we now know; Holden C. Richardson, '06, recognized for his early work on hydroplanes and flying boats; Godfrey L. Cabot, '81, who conducted early tests with the hydroplane and taught himself to fly at a time when he was then 20 years overage; George C. Westervelt, '06, who was instrumental in starting the Boeing Aircraft Company; and Frank W. Caldwell, '12, who invented the variable pitch propeller.

World War I developed the airplane into a useful vehicle. Alumni active during that period included: Luis de Florez, '11, who pioneered in aircraft instrumentation; and Paul W. Litchfield, '96, who contributed to improving the airship art, and built the *Akron* and *Macon*.

After World War I, the airplane was further developed for mail, passenger service, and other civilian uses. Alumni who made major contributions during this period include: Donald W. Douglas, '14, who developed the torpedo airplane into the DC-3 – the first airplane that made money as a civil carrier; Arthur E. Raymond, '21, Vice-president in charge of engineering with the Douglas Aircraft Company; the late George J. Mead, '16, who developed the Pratt and Whitney engine; John W. Crowley, Jr., '20, who played a particularly prominent part in wind-tunnel research with the National Advisory Committee for Aeronautics; James H. Doolittle, '24, the first to conduct blind flying experiments; and Theodore P. Wright, '18, who was awarded the Guggenheim Award for Safe Aircraft Competition.

Today, world-wide transport services facilitate international trade, cultural exchange, and provide opportunity for statesmen to meet face to face. Again M.I.T. Alumni are playing prominent roles in aviation, such as: Edward P. Warner, '17, (formerly on the M.I.T. Faculty), who, as President of the Council, International Civil Aviation Organization, arbitrates the problems for international air lines; Emory S. Land, '07, who is consultant and director, General Dynamic Corporation; and Clarence D. Howe, '07, Minister of Trade and Commerce, who established the Canadian National Airlines.

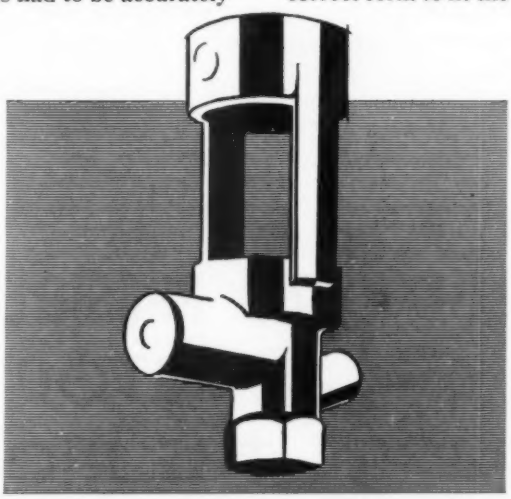
In discussing "Current Changes in Management Philosophy, Professor McGregor particularly emphasized three points of current concern to management. There is a growing recognition that labor and management are mutually dependent upon one another for the successful operation of any business, and that a genuinely co-operative attitude on the part of both groups results in greatest benefits for all. Likewise there is growing recognition that management must be alert and willing to remove injustices to which employees at all levels may be subjected, and must take the lead in removing discriminations against individuals for reasons beyond the control of the individual. Finally, it is being recognized that a certain degree of dissatisfaction tends to foster initiative which can be turned to benefit, especially under the stimulation of proper incentives. Attempts at removal of all sources of dissatisfaction may result in paternalism and diminution of initiative.

(*Continued on page 152*)

BUSINESS IN MOTION

To our Colleagues in American Business . . .

There is an interesting story behind the brass forging shown here. It is part of a high-pressure lubricator. Originally a casting was used, but this proved to be more expensive than expected, due to blow holes, sand inclusions and the like; there were too many leakers, too many rejects. It then was decided to assemble the part out of four different brass items. The bottom was a forging, the top was machined out of round brass rod, and the two side supports were rectangular brass rod. To assemble, the four parts had to be accurately aligned, and silver soldered together. The result was an improvement, but costs were still too high, due to the time-consuming assembly process, and the expensive silver solder.



It was then suggested that the entire part perhaps could be made as a one-piece forging. Could Revere do it? We thought we could, and our forging people sat down with the lubricator manufacturer, studying blueprints and specifications. When both parties thoroughly understood both the possibilities and the limitations a bid was made, and accepted. Introduction of the forging on a production basis showed sizable economies. Machining is done more quickly, output is increased, rejects have decreased to practically zero. In addition, the part is better in every way.

The forging process is an excellent one, and has wider applications than many people realize. As in the case reported here, rather intricate shapes can be forged, shapes that many people would consider would have to be built up of several parts. The Revere files contain many similar examples of parts formerly expensively put together but now delivered to the customer in a one-piece forging, with resultant economies.

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The point about this story is that Revere, as a supplier, was able to collaborate with a customer, and show how to use a special process to make an intricate part better and at less cost. Perhaps your business, no matter what it is, could benefit by the knowledge and skill of your suppliers. They know what can be done with their materials. Why not take them into your confidence, and ask them how you can save money? It might very well pay you handsomely.

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THE INSTITUTE GAZETTE

(*Continued from page 150*)

Summary on Mechanical Engineering

THE Visiting Committee on the Mechanical Engineering Department* met on November 20, 1953, with three principal projects on its agenda: (1) The revitalization of the Mechanical Engineering Laboratory; (2) A review of the graduate and undergraduate curricula of the Department; and (3) Plans for the completion of the Edward F. Miller Room.

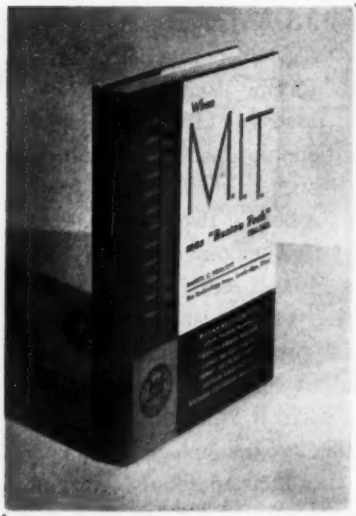
The report of the Visiting Committee, reviewed at the March 1, 1954, meeting of the M.I.T. Corporation and the June 4 meeting of the Executive Committee, was received for publication in The Review on September 29.

Plans to revitalize the Mechanical Engineering Laboratory stem from educational demands which today are very different from those in 1917 when the laboratory was an outstanding feature of the new Institute plant. Many of the original functions are now performed by specific professional laboratories – Gas Turbine, Hydrodynamic, Sloan Automotive, and others. In the field of power generation, the equipment which once typified contemporary practice is now obsolete and, although there has been some replacement with current items, the acquisition and utilization for teaching purposes of full scale, modern, prime movers is today out of the question at the Institute.

The educational role of the laboratory in the new curriculum has also changed significantly. The scope of the laboratory program is gradually being extended to cover the whole of mechanical engineering rather than being limited to the field of power. To an increasing extent, laboratory instruction is being presented through authentic projects from industry. The objective of the new laboratory is not only to give the students a vision of the past, present, and future in the field of mechanical engineering, but also to expose them to the stimulating influence of participation in creative efforts. Experience of the Department over the last few years indicates that it is possible to organize projects of sufficient scope to insure some measure of achievement on the part of the students during a term. The students develop an intensive interest in the project itself; this interest gives meaning to their efforts in fundamental studies, and eventually their experience provides interesting material for more meaningful report writing. When the various roles of the new laboratory have been fully exploited, there is firm evidence to indicate that it will become one of the most important educational facilities in the Department.

(*Continued on page 154*)

*Members of this Committee for 1953-1954 were: John A. Lunn, '17, chairman, Redfield Proctor, '02, Walter J. Beadle, '17, Charles A. Chayne, '19, H. W. McCurdy, '22, Thomas H. West, '22, John F. Bennett, '30, and Ronald B. Smith.



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THE INSTITUTE GAZETTE

(*Continued from page 152*)

A detailed plan for the physical renovation of the laboratory was presented and discussed. The outstanding feature of the proposal is a dynamic power museum, integrated with equipment and space for formal laboratory instruction, as well as facilities for engineering research. The total cost of the project is estimated at $130,000, which would be spread over several years, with an initial outlay estimated at $75,000 which would be needed during the first year. The largest items of initial expenditure are for a new lecture room and related classrooms which would cost approximately $50,000.

The Committee unanimously endorsed the plan for revitalizing the Mechanical Engineering Laboratory and urged that the project be undertaken as soon as agreement could be reached between the Department and the Administration as to the specific details of the plan and its implementation.

Professor C. Richard Soderberg, '20, and other members of the Department reviewed the revisions in the undergraduate curriculum which have taken place during postwar years, and in which recent Visiting Committees have taken an active interest. During the same period, educational programs in the Graduate School have also matured and sponsored research has shown further growth. The Committee was en-

(*Continued on page 156*)

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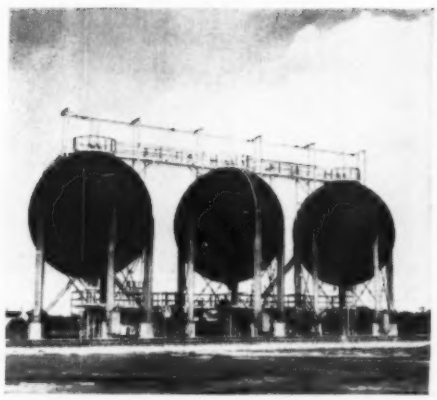

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(*Continued from page 154*)

thusiastic about the accomplishments in these areas and hoped that progress would continue.

The 1952-1953 Visiting Committee sponsored an appeal to Course II Alumni for a fund of $30,000 to underwrite an Edward F. Miller Room in the Mechanical Engineering Headquarters and a Student Commons Room in the basement. Something over $10,000 was raised which was not enough to complete the original project. Further consideration indicated the desirability of combining the two projects into a single plan, comprising the complete rehabilitation of the basement area, Room 3-070, as the Edward F. Miller Room which would be utilized under the supervision of the Department. This will provide a needed facility for seminars, informal get-togethers between students and staff, and for student affairs.

Since this is inside space, it will be necessary to air condition it completely and to install modern lighting. The estimated cost of the revised project is $15,000, of which almost $14,000 has been raised, so that it can be started without delay. The Committee believes that it will be a valuable addition to the Department's facilities and will offer significant benefits to both students and faculty.

Walter W. Robertson: 1890-1954

WALTER W. ROBERTSON, Assistant Professor of Ship Construction, for 15 years a member of the Faculty of the Department of Naval Architecture and Marine Engineering, died on October 30, 1954. He was 64 years old.

A native Bostonian, Professor Robertson joined the Institute Faculty as instructor in naval architecture after 24 years' experience in American shipyards. He was promoted to the grade of assistant professor in the Department in 1945. His service in industry and government included positions as draftsman on submarine construction with the Electric Boat Company in New London, Conn.; as leading draftsman in charge of Warship Lines, Newport News Shipbuilding and Dry Dock Company in Newport News, Va.; assistant naval architect with the U. S. Navy Yard in Brooklyn, N. Y.; and chief engineering draftsman, Office of Superintending Constructor, U.S.N., Fore River Plant of Bethlehem Steel Company in Quincy, Mass.

(*Continued on page 158*)

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We especially extend our gratitude to Professor Charles M. Spofford and the late Professors George F. Swain and Alfred E. Burton. These men went outside their regular teaching duties to help us when we needed encouragement in our pioneering statistical and forecasting work.

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(*Continued from page 156*)

Library Study

A COMPREHENSIVE review of the Institute's library facilities, budget, and operations was made at the March 19, 1954, meeting of the Visiting Committee on the Library.* The report of this Committee, dated June 11, was approved for publication and received by The Review on September 29, 1954, and a condensation is presented below. Members taking part in the March 19 meeting were: John J. Desmond, Jr., chairman, Charles W. David, William Emerson, William W. Garth, Jr., '36, Carl T. Keller, Ralph T. Walker, '11, and Walter M. Whitehill. Pierre F. Lavedan, '20, was in South America. By invitation, Vernon D. Tate, Director of Libraries, and Robert E. Booth, Associate Librarian, were present. Attending a portion of the meeting were James R. Killian, Jr., '26, President, and Michael B. Bever, '42, chairman, Executive Board of Faculty Committee on the Library. Chairman Desmond convened the meeting at 10:00 A.M., and reviewed recommendations in the Visiting Committee report of October, 1953, which served as the basis for the agenda.

The physical status of the libraries was reviewed. No changes will be required for the General Library and for the Dewey Library of Industrial Management, although the branch library will require additional space in the next few years. Minor acoustical treatment and entry changes have been suggested for the Science Library. The Engineering Library and the Rotch Library of Architecture and City Planning are urgently in need of new lighting which the Visiting Committee recommended be completed as soon as possible. It was recommended that a mezzanine be built at one end of the second floor of the Hayden Library, and that the Humanities Library be moved to this location.† This move will leave the space vacated by the Humanities Library as a Reserve Book and Reading Room. A separate through passage on the west side of the Hayden

*Members of this Committee for 1954–55 are: John A. Lunn, '17, chairman, Luis de Florez, '11, Ralph T. Walker, '11, Pierre F. Lavedan, '20, John W. Barriger, 3d, '21, Charles W. David, William Emerson, Carl T. Keller, and Walter M. Whitehill.

†This change has been made during the summer.

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Library is needed, and the Committee urges that provision be made for a separate corridor. The Committee feels that the M.I.T. libraries are in physically good condition.

The Committee reviewed the Library's budget, especially with respect to salaries of its devoted and well-trained staff and also with respect to acquisition funds. The total library budget in 1940 amounted to $75,000 and in 1952 this figure had grown to $235,000. While this is a good record, it is by no means a distinguished one. The Committee felt that budgets for salaries and acquisitions should be augmented to keep pace with current and growing needs.

In its report of 1953, the Visiting Committee observed that the Dean of the School of Humanities provided liaison between the library and the Institute's Administration and urged that this matter be studied. President Killian indicated that the whole administrative structure of the Institute was under study. The present arrangement is operating satisfactorily.

An Industrial Reference Service which would make the M.I.T. Library available to industry in the Boston area on a supporting basis was outlined. The Committee feels this service to be a useful and desirable addition to library facilities. The Committee feels that adequate, rapid photocopying facilities, which would be required for this service, should be installed and operated by the library to establish service facilities comparable to those in other large research libraries in the country.

Progress by Physicists

THE Visiting Committee on the Department of Physics* held a well-attended series of meetings in Cambridge on March 3 and 4, 1954. The report of the Committee, summarized below, was reviewed at the June 11, 1954, meeting of the M.I.T. Corporation and the September 17, 1954, meeting of the Executive Committee. It was released for publication in The Review on September 29.

James R. Killian, Jr., '26, President was present at the start of the meeting on Wednesday morning, March 3, at which meeting Professor Nathaniel H.

(*Concluded on page 160*)

*Members of this Committee for 1953-1954 were: Thomas C. Desmond, '09, chairman, Ralph P. Johnson, '36, William Shockley, '36, Edward U. Condon, Mervin J. Kelly, Alfred L. Loomis, I. I. Rabi, and Alan T. Waterman.

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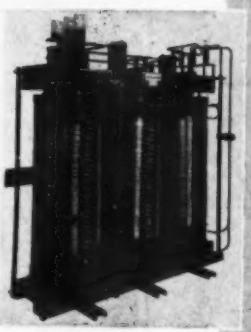
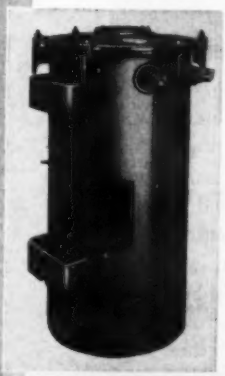
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THE INSTITUTE GAZETTE

(*Concluded from page 159*)

Frank, '23, Head of the Department, discussed in some detail the new Physics curriculum. This curriculum, on which a great deal of effort has been spent, is designed to permit as much flexibility as is consistent with high standards of achievement. In the usual four-year course, a student of exceptional ability could gain nearly a year in his progress toward an advanced degree. On the other hand, a student desiring a more leisurely pace, or the chance to expand his training into other fields, could do so without being hard-pressed. There was considerable discussion regarding the requirement of a language achievement test. It was felt that such a requirement would be realistic only if some use were made of the foreign language in the third and fourth years.

The actual content of several of the third and fourth year subjects was discussed in some detail. Although agreement was not unanimous as to the ideal content, it was generally felt that the objectives were right.

Professor M. Stanley Livingston next discussed a proposal for a high-energy accelerator (in the 15 billion electron volt range) for the "Cambridge area." It was estimated that construction would cost about $2,500,000 and require two or three years. In addition, operation and maintenance was estimated to require a continuing amount of about $1,000,000 per year. The Committee felt that, because of the present progress in high-energy physics, and in order to maintain leadership in the field, M.I.T. and Harvard might well ask for support in building and operating such an accelerator jointly, under terms which would not involve too onerous financial burdens on either institution.

After lunch at the M.I.T. Faculty Club, with a small group from the Physics Department, Wednesday afternoon was devoted to an inspection of the undergraduate laboratory facilities. The Committee was particularly impressed with the zeal of the students working on such things as the Millikan Oil Drop experiment, the Zeeman effect, microwave measurements, and so on, in the junior laboratory.

At the Thursday morning, March 4, session of the Committee, the Director of the Research Laboratory of Electronics, Professor Jerome B. Wiesner of the Department of Electrical Engineering, outlined some of the history of the origin of this laboratory, which came into being with the termination of the wartime Radiation Laboratory operated by M.I.T. for the Office of Scientific Research and Development. He emphasized the close co-operation between the Departments of Electrical Engineering and Physics, and the advantages that have come about because of this. The general fields of research being carried out were discussed in some detail. Peter T. Demos, '51, Assistant Director of the Laboratory for Nuclear Science, next outlined the research program of that laboratory, and the personnel involved.

Following these talks the Committee visited several of the research projects in the laboratories.

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(*Concluded from page 142*)

are working on many other possible uses of these new tools.

Outlook for the More Distant Future

Thus far, primarily, the outlook for the next 25 years has been discussed. Beyond that time, any predictions are bound to involve more and more uncertainty, not only because of unforeseen developments in the utilization of atomic energy, but because of uncertainties regarding the rate of discovery of oil in the more distant future. It is true that as oil gets harder to find, the long-time trend of petroleum costs and prices is upward and likely to continue that way; whereas the trend of atomic power costs is downward and should continue that way for at least the next two decades. The two curves will presumably meet sometime, but apparently well into the future. However, the country's needs for energy are expanding so rapidly (certainly more than doubling in the next 25 years) that the ultimate problem is not what fuel is going to be crowded out, but what can come along to help carry the rapidly growing load. Petroleum's present advantage in most of its fields of usefulness is so large that only a very major increase in price could prevent it from having all the business it will be able to handle far beyond the next 25 years. It is much more certain that we will find early use for all the petroleum we discover in this country than it is for uranium—our weapons requirements will certainly decline and breeder reactors will sharply reduce prospective uranium requirements for generating a given amount of power.

Barring a world cataclysm, world population in the next century is almost certain to increase by threefold and its power requirements at least tenfold. With this outlook, the author, for one, welcomes atomic energy with open arms. For the long pull it will be, not a competitor, but a burden sharer; and its ultimate availability should still the recurrent cry that we are running out of oil and that the government should therefore take us over. Atomic energy today needs both industrial and governmental help. The oil industry has proven rather conclusively that it can do a highly efficient job as a private enterprise. The availability of atomic energy should help us keep it that way, and is therefore doubly welcome.

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MATURITY THROUGH STUDENT COUNSELING

(*Concluded from page 145*)

instead of being dominated by emotions. He is flexible, tolerant, has a good sense of humor, respects himself and other people, is responsible and can relate himself to other people.

Sidney Hook has said that emotional maturity connotes among other things the habit of reasonable expectation. For this the individual needs a knowledge of himself and a historical prospective together with "an awareness of how the best of men fall far short of their own ideals." Emotional maturity is acquired slowly, cannot be forced, and like most virtues is more likely to be achieved by indirection. Hook goes on to say that intellectual maturity is the capacity for reasonable assessment of evidence. The mature man does not assume that knowledge in one field carries over into another. His thinking is effective only when it reveals command of subject matter. It requires respect for, but not worship of, facts.

The mature person lives in harmony with his conscience. He can live without certainty and not be overwhelmed by anxiety. He makes the most of what he has, rather than being preoccupied with what he cannot have.

Part II, the conclusion of Dr. Farnsworth's article, to appear in the February, 1955, Review, discusses the theoretical and practical aspects of student counseling, and the aims of the counselor-teacher at M.I.T.

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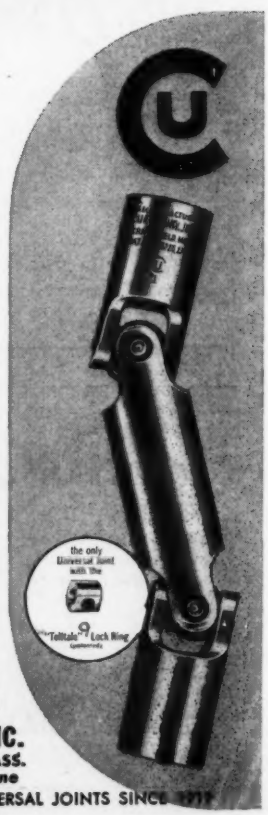

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MAPS, OLD AND NEW

(Concluded from page 138)

marginal data, common geodetic datum, and common military grid (Universal Transverse Mercator). The U.T.M. grid replaces 17 grids formerly used in western Europe. The second phase of this program, bringing existing maps up to date, has begun. N.A.T.O. countries are now preparing international standards for symbols, scales, sheet lines, and terminology. When accomplished, this standardization will permit large savings in time and money.

Modern maps have many uses. Wars have always required maps and stimulated new techniques for making them. In a military operation maps are as essential as bullets. World War II and the Korean conflict revolutionized making of maps for military purposes. No longer are military operations localized activities—they have assumed a global aspect. Today the military must know locations, not in the next valley or over the next hill, but on the other side of the world. As our world has grown smaller with the development of high-speed transportation and communications, our need for world-wide mapping has increased tremendously.

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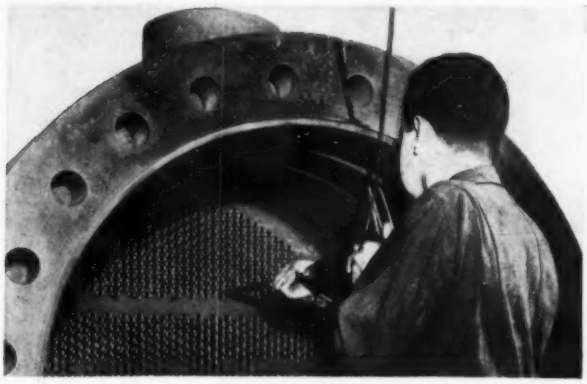

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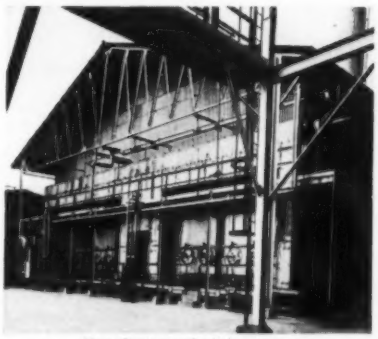

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50,000,000 Beam Candles

To Help Parker Design Fuel Nozzles for Jet Engines

Fuel nozzles for high-performance jet engines must be carefully designed for the desired range and magnitude of droplets in the fuel spray. The Parker Appliance Company, Cleveland, Ohio, has found photographic techniques made possible by the G-R Microflash® most satisfactory for this work. To quote Ned Shiflet, Manager of the Engine Accessories Division:

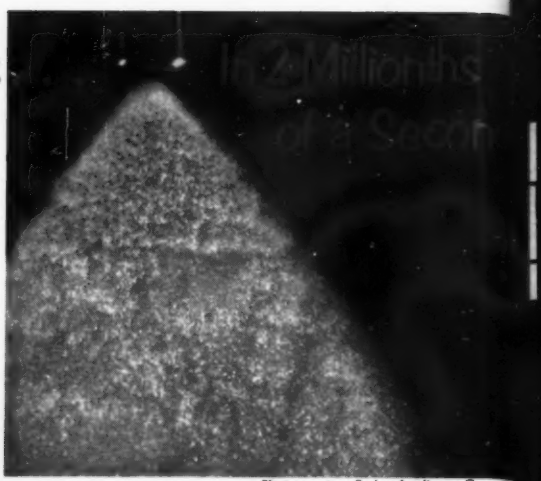
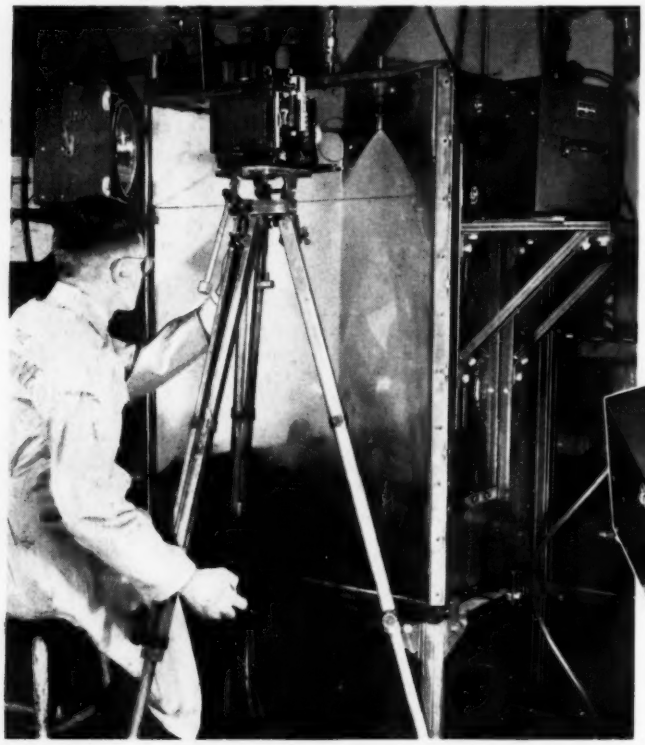


Photo courtesy Parker Appliance Company



"Flash bulbs of 1/80 second to 1/170 second light duration would not stop the high-velocity droplets in the atomized fuel spray. A commercially available high-speed electric flash with light durations as small as 1/30,000 second was also found unsatisfactory.

"Excellent photographs are now obtained using two synchronized Microflash units. These are located approximately 15 inches from the spray cone at 90°. Full size enlargements can easily be made and droplet sizes qualified. Photographs obtained are studied under a calibrated microscope, to determine actual droplet sizes."

Another Microflash® Application

Type 1530-A Microflash® $640.00

This is one more example of the value of ultra-high-speed photography made possible by the G-R Microflash. This instrument will stop objects moving as fast as 1,000 feet per second. It has been used for many diverse research and development jobs including investigations of projectiles in motion, pressure waves in gases, turbulence in liquids, and mechanical distortions at high rotational speeds.

The Microflash is portable, operates from a-c lines and can be used with conventional camera equipment.

Flash Duration – 2 microseconds

Triggering – Pushbutton initiates flash – flash can also be triggered by sound or pressure wave produced by the action to be photographed; microphone and built-in amplifier are provided for this use.

Power Supply – 105-125 or 210-225 volts, 50-to-60 cycles.

Accessories Supplied – Microphone with cable, tripod, spare pilot lamp and fuses, 2 spare flash lamps, plug for contactor-trip jack.

Mounting – Power Supply and trigger circuits are in one metal case, the flash lamp in another. Both cases lock together for ease in transportation, and complete protection of lamp and controls.

Dimensions – 24¼ x 13¼ x 11⅜ inches. **Net Weight** – 72 pounds

We sell direct. Prices shown are NET, f.o.b. Cambridge or W. Concord, Mass.

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